OCA PAD INITIATION - PROJECT HEADER INFORMATION 10/10/88

Project #: D-48-624  Cost share #:  Rev #: 0
Center #: R6599-0A0  Center shr #: OCA file #:  Work type: RES
Contract #: DACAB8-88-H-1443  Mod #:  Document: CONT
Prime #:  Contract entity: GTRC

Subprojects ?: Y
Main project #:  

Project unit: ARCH COLL
Project director(s): GIREZI JR
Sponsor/division names: ARMY
Sponsor/division codes: 102

Award period: 880912 to 900111 (performance) 900111 (reports)

Sponsor amount
Contract value 24,944.54
Total to date 24,944.54
Funded 24,944.54
0.00

Cost sharing amount

Does subcontracting plan apply?: N

Title: GENACTI PLANNING SUPPORT

PROJECT ADMINISTRATION DATA

OCA contact: William F. Brown 894-4820
Sponsor technical contact

MR. ALAN MORE
(217) 373-7267
US ARMY CONSTRUCTION, ENGR RES. LAB.
NEWARK DR., P.O. BOX 4005
CHAMPAIGN, IL 61820-4005

Security class (U.S.S.TS) C
Defense priority rating: DQ-C9
Equipment title vests with: GTR X
NONE PROPOSED OF ANTICIPATED.

Administrative comments -
INITIATION OF D-48-624. THIS IS A FIXED PRICE PURCHASE ORDER.
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Subprojects #: N  
Main project #: D-48-624

Project unit: LIBRARY  
Project director(s):  
DRANE M A

Sponsor/division names: ARMY  
Sponsor/division codes: 102 / CON ENG RES LAB, IL / 020

Award period: 880912 to 900111 (performance) 900111 (reports)

Sponsor amount  
Contract value 4,979.84  
Funded 4,979.84  
Total to date 4,979.84

Cost sharing amount 0.00

Does subcontracting plan apply #: N

Title: CENACTI PLANNING SUPPORT

PROJECT ADMINISTRATION DATA

OCA contact: William F. Brown 894-4820

Sponsor technical contact
MR. ALAN MARE
(217)373-2767

US ARMY CONSTRCT: ENGR RES LAB
NEWARK DR., P.O. BOX 4005
CHAMPAIGN, IL 61820-1305

Security class (U,S,S,T,S): U  
Defense priority rating: D0-C9  
Equipment title vests with: Sponsor  
NONE PROPOSED OF ANTICIPATED.

Administrative comments -

INITIATION OF SUBPROJECT A-51-601 UNDER MAIN PROJECT D-48-624/CIRCEG/ARCH  

HM. V. IVERSON/CONTRACTS BRANCH  
(217)373-6798

US ARMY CONSTRCT: ENGR RES LAB
2902 NEWARK DR., P.O. BOX 4005
CHAMPAIGN, IL 61820-1305

ONR resident rep. is ACO (Y/N): N

NA supplemental sheet  
GIT X
**Project #:** E-20-610  
**Center #:** R6599-0A1  
**Contract #:** DACA88-88-M-1443  
**Prime #:**  

**Subprojects #:** N  
**Main project #:** D-48-624  

**Project unit:** CE  
**Unit code:** 02.010.116  
**Project director(s):** RIGGS, L.S. CE  
**Sponsor/division name:** ARMY  
**Sponsor/division codes:** 102  

**Award period:** 880912 to 900111 (performance) 900111 (reports)  

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**Does subcontracting plan apply ?:** N  

**Title:** CENACT PLANNING SUPPORT

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**PROJECT ADMINISTRATION DATA**

**OCA contact:** William F. Brown 894-4820  
**Sponsor technical contact**  
**Sponsor issuing office**  
<table>
<thead>
<tr>
<th>M.R. ALAN MORE</th>
<th>MS. V. IVerson/CONTRACTS BRANCH</th>
</tr>
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<tbody>
<tr>
<td>(217)373-7267</td>
<td>(217)373-6798</td>
</tr>
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**US ARMY CONSTRUCT. ENGR. RES. LAB.**  
**NEWMARK DR., P.O. BOX 4005**  
**CHAMPAIGN, IL 61820-1305**  
**Security class (U,C,S,T,T):** U  
**ONR resident rep. is ACO (Y/N):** N  
**Defense priority rating:** DO-C9  
**NA supplemental sheet**  
**Equipment title vests with:** Sponsor GIT X  
**NONE PROPOSED OF ANTICIPATED.**  

**Administrative comments**  
INITIATION OF SUBPROJECT E-20-610 UNDER MAIN PROJECT D-48-624/CIRCEO/ARCH.
**OCA PAD INITIATION - PROJECT HEADER INFORMATION**  
10/10/88

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Subprojects ?: N  
Main project #: D-48-624

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<td>CONT ED</td>
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<tr>
<td>HUTTMAN'S D</td>
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Sponsor/division names: ARMY  
Sponsor/division codes: 102

/ CON ENG RES LAB, IL  
/ 020

Award period: 880912 to 900111 (performance) 900111 (reports)

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Cost sharing amount: 0.00

Does subcontracting plan apply ?: N

Title: CENACTI-PLANNING-SUPPORT

**PROJECT ADMINISTRATION DATA**

OCA contact: William F. Brown 894-4820

<table>
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<tr>
<th>Sponsor technical contact</th>
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<tr>
<td>MR. ALAN MORE</td>
<td>MS. V. IVerson/contracts branch</td>
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<td>(217)373-7267</td>
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<tr>
<td>NEWARK DR., P.O. BOX 4005</td>
<td>2902 NEWARK DR., P.O. BOX 4005</td>
</tr>
<tr>
<td>CHAMPAIGN, IL 61820-1305</td>
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Security class (U.S.S.TS) : U

ORR resident rep. is ACO (Y/N): N

Defense priority rating : DO-C9

NA supplemental sheet

Equipment title vests with: Sponsor

GIT X

NONE PROPOSED OF ANTICIPATED.

Administrative comments -  
INITIATION OF SUBPROJECT X-20-601 UNDER MAIN PROJECT D-48-624/CIRCEQ/ARCEQ
NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 02/12/91

Project No. D-48-824  Center No. R6599-0A0
Project Director CIRCEO L JR.  School/Lab DEAN ARCH
Sponsor ARMY/CON ENG RES LAB, IL
Contract/Grant No. DACA88-88-N-1443  Contract Entity GTRC
Prime Contract No.

Title CENACTT PLANNING SUPPORT

Effective Completion Date 900630 (Performance) 900630 (Reports)

Closeout Actions Required:  Y/N  Submitted

Final Invoice or Copy of Final Invoice  Y
Final Report of Inventions and/or Subcontracts  Y
Government Property Inventory & Related Certificate  Y
 Classified Material Certificate  N
Release and Assignment  Y
Other

Comments

Subproject Under Main Project No. 

Continues Project No. 

Distribution Required:

Project Director  Y
Administrative Network Representative  Y
GTRI Accounting/Grants and Contracts  Y
Procurement/Supply Services  Y
Research Property Management  Y
Research Security Services  N
Reports Coordinator (OCA)  Y
GTRC  Y
Project File  Y
Other  N

NOTE: Final Patent Questionnaire sent to PDPI.
MEMORANDUM FOR RECORD

SUBJECT: Minutes of the Corps of Engineers National Alternate Construction Technology Team (CENACTT) Meeting Oct 25-27, 1988 at Georgia Tech's Education Extension facilities in Atlanta, Georgia.

1. References:
   a. Agenda for the subject meeting, encl. 1
   b. List of Attendees, encl. 2.
   c. CETAP briefing slides and draft of recommendations and conclusions, encl. 3
   d. Fact Sheet on Cathodic Protection, encl. 4
   e. Construction Research Center information, encl. 5
   f. Proposed FY 89 Funding, encl. 6
   g. Draft CENACTT mission statement, encl. 7
   h. FTAT Information, encl. 8

2. The meeting began at 8:45 on Tuesday, October 25, 1988 and was held in Georgia Tech's Education Extension Computer facilities in the Pierremont Plaza Hotel. Dr. Thomas E. Stelson, Executive Vice President, Georgia Institute of Technology welcomed the group. He lauded CENACTT for its service activities and cited Georgia Tech as the third largest institution of technology research (after MIT and Johns Hopkins).

   Dr. Linda Martinson, Assistant to the President, Georgia Tech, and Senior Research Scientist narrated a slide presentation informing CENACTT members about Georgia Tech's new and ongoing research on 'commercial' products.

3. CENACTT members toured the Tech campus with visits and/or demonstrations in the Geotechnical Laboratory (including a look at geotechnical research projects), the Student Center, and library facilities with a discussion of a technology transfer and information retrieval center.

4. Don Dressler gave an overview of CPAR which is a partnership between Corps of Engineers and private industry in performing research. Congress or a congressional committee has just approved the program.
g. Exterior Insulation. Systems are adaptable to Army-type buildings. Scope of work includes a general description of the systems, and the failure modes of the systems. A "lessons learned" report will be ready by March '89. Permission was requested to write separate report on inspection criteria with no expectation of immediate answer to request.

7. Dr. Leland "Buck" Riggs, Associate Professor, Georgia Tech outlined the format of a potential CENACTT Newsletter. Suggested 8 1/2 X 11 format as most cost effective, and showed two examples. Choice of format is CENACTT’s. Suggested Wordperfect 5.0 or more sophisticated Desktop Publishing system. Dr. Riggs also suggested that CENACTT do a professional journal, inviting people to write with concomitant peer review.

8. Dr. Louis J. Circeo, Director Construction Research Center (CRC), Georgia Tech, briefed CENACTT about the Center. CRC was established to function as a base for information exchange on construction; conduct R&D program responsive to the needs of the construction community; disseminate research results of in-house and out-of-house research. Support to the CRC includes the library which has capabilities of: 400 on-line databases, 2 million catalog volumes, 2 million technical reports, scientific publications, research information services.

Other support includes the Education Extension Program at Georgia Tech, number one in continuing education (ahead of MIT, Stanford, and Wisconsin) with over 800 courses offered annually, and specialized training. These statistics were given to emphasize the ease of assembling a Georgia Tech team to go out and train others in technology.

Dr. Circeo presented Georgia Tech's potential role as a liaison between CPAR (Construction Productivity Advancement Research) and CENACTT. CPAR was established to reverse declining construction productivity and improve competitiveness. There is a commitment to formulate a plan to coordinate CENACTT and CPAR, and to get one newsletter out within a six month period. Jim Perry will serve as the point of contact.

An ad hoc committee composed of Richard Lampo, Allen Hurlocker, Bradford Brightman, and Jack Story, was set up to work with Dr. Circeo and Georgia Tech library personnel on an information retrieval system.

9. In the interest of time the briefing and demonstration of the SPECRITE System by Mr. Eric J. Wimer was postponed.

10. Proposals for FY 89 CENACTT Program. Don Dressler passed out a list of projects for the FY89 program which had priority designations. Additional funds for FY 89 projects would be based
### CENACTT MEETING
#### 25-27 OCTOBER 1988
PROPOSED GEORGIA TECH AGENDA ITEMS

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Speaker/POC</th>
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</table>
| 0845 - 0900 | Welcome to Georgia Tech                                      | Dr. Thomas E. Stelson  
Executive VP, GIT |
| 0900 - 0930 | Research at Georgia Tech                                     | Dr. Linda Martinson  
Asst. to the Pres., GIT |
| 0930 - 0945 | Overview of Georgia Tech Contract Support to CENACTT         | Dr. Louis Circeo, Director  
Construction Research Center |
| 0945 - 1000 | Break                                                        | GTEE |
| 1000 - 1010 | Travel to Georgia Tech                                        | GTEE |
| 1010 - 1050 | GTSTRUDL, Demonstration and Marketing Discussion             | Dr. Lawrence F. Kahn  
GTICES Laboratory |
| 1050 - 1100 | Travel to Geotechnical Laboratory                            | GTEE |
| 1100 - 1130 | Tour of Geotechnical Research Projects                      | Dr. Richard D. Barksdale  
Professor, Civil Engineering |
| 1130 - 1140 | Travel to Wenn Student Center                                | GTEE |
| 1140 - 1220 | Lunch, 3rd Floor Dining Room                                 | GTEE |
| 1220 - 1230 | Walk to Gilbert Memorial Library                             | GTEE |
| 1230 - 1320 | Tour of Library Facilities; Discussion of Technology         | Ms. Miriam A. Drake  
Dean/Director of Library |
|           | Transfer & Information Retrieval Center Concepts              | |
| 1320 - 1330 | Travel to Pierremont Plaza Hotel                             | GTEE |
| 1330 - 1400 | Overview Briefing on CPAR Productivity Advancement Research Program | CEEC |
| 1400 - 1415 | Break                                                        | |
Thursday, 27 October

0800 - 1100  Meeting of CENACTT Steering Committee*

1100  ADJOURN Steering Committee Meeting

*Steering Committee is composed of representatives from CEEC, Division and District Offices and the laboratory liaison member from each of the Corps Labs.
CENACTT ATTENDEES
OCTOBER 24-27, 1988

LOUIS CIRCEO
CONSTRUCTION RESEARCH CENTER
GEORGIA TECH
ATLANTA, GA  30332
404-894-2070

STEVEN DENHARTOG
U.S.A.  CRREL
72 LIME ROAD
HANOVER, NH  03755
603-646-4337

DON DRESSLER
HQ USACE
WASHINGTON, DC  20314
202-272-8815

PAUL HOWDYSHELL
USA-CERL
PO BOX 4005
CHAMPAIGN, IL  61873
217-373-7244

ALLEN HURLOCKER
CEEC-CP
20 MASSACHUSETTS AVE., NW
WASHINGTON, DC  20314-1000
202-272-1263

RICHARD LAMPO
USA-CERL
PO BOX 4005
CHAMPAIGN, IL  61820
217-373-6765
217-352-6511

THOMAS R. NAPIER
USA-CERL-FS
CHAMPAIGN, IL
217-373-7263

JAMES L. PERRY III
CESAD-EN-TS
77 FORSYTH STREET, ROOM 313
ATLANTA, GA  30335-6801
404-331-6738
ENCLOSURE 3
CETAP
CORPS OF ENGINEERS TECHNOLOGY
ADOPTION PROCESS STUDY
CETAP
OBJECTIVES

1. INVENTORY OF ALL USACE MECHANISMS FOR INCORPORATING NEW / ALTERNATE TECHNOLOGIES

2. ASSESS THE PERFORMANCE OF THESE TECHNOLOGY ADOPTION MECHANISMS

3. DEVELOP NEW OR MODIFY EXISTING MECHANISMS TO IMPROVE USACE PERFORMANCE IN NEW TECHNOLOGY INCORPORATION
CETAP

PRODUCT OF RESEARCH

TASK 1. INVENTORY OF ADOPTION MECHANISMS

TASK 2.

A. HQ USACE P-O-C LIST

B. FINDINGS ON PERFORMANCE OF EXISTING MECHANISMS AND IDENTIFICATION OF AREAS FOR IMPROVEMENT

TASK 3. SYSTEMATIC EVALUATION PROCEDURE TO ASSESS THE APPLICABILITY OF NEW TECHNOLOGIES
ADOPTION MECHANISMS

1. SITE SPECIFIC

2. GENERAL CASE
MCA CONSTRUCTION PROCESS

SPECIAL PROGRAMS' NEW TECHNOLOGY

NEED → DD FORM 1391 → HQ USACE REVIEW/APPROVAL → 35% DESIGN → DISTRICT REVIEW → DIVISION REVIEW/APPROVAL

NEW TECHNOLOGY (DESIGNER INITIATED)

HQ USACE APPROVAL

NEW TECHNOLOGY USER/REVIEWER INITIATED

90% FINAL DESIGN

DISTRICT REVIEW

COMPLETE DESIGN

ADVERTISE

CONTRACT

CONSTRUCT

SPECIAL PROGRAMS: VALUE ENGINEERING, SUGGESTION, MODEL DISTRICT
FIVE STEP TECHNOLOGY ADOPTION PROCESS

STEPS

#1
ARMY NEED/TECH OPPORTUNITY

#2
SMART BUYER R&D

#3
FIELD DEMO

#4
PRODUCT/SYSTEM AUTHORIZATION

#5
PRODUCT/SYSTEM APPLICATION

R/D PHASE

TECH TRANSFER PHASE
INDUSTRY PUSH/CONSUMER EVALUATION

- HOW TO EVALUATE
- HOW TO SPECIFY
- ROLE OF TTTB/FTAT
LOCATIONS BEING SURVEYED

- CORPS FIELD OPERATING AGENCIES / OCE
- INSTALLATION DEH / AIR FORCE COMMAND
- NON CORPS GOVERNMENT
- PRIVATE INDUSTRY
- TRADE ASSOCIATIONS
- VENDORS
I. INITIATIVE/RESPONSIBILITY FOR INTRODUCING NEW TECHNOLOGIES
II. PROCEDURES FOR INTRODUCING NEW TECHNOLOGIES
INFLUENCE OF CORPS OF ENGINEERS GUIDE SPECIFICATIONS (GS)

SURVEY RESULTS INDICATE THE FOLLOWING:

- "IF IT ISN'T IN THE GS, IT ISN'T ALLOWED TO BE USED ON CORPS' PROJECTS"
- "STIFLES THE ABILITY TO USE NEW TECHNOLOGIES"
- APPROXIMATELY HALF STATED THE GS DO NOT REFLECT STATE-OF-THE-ART (MARKET).
- TECH MANUALS PARTICULARLY BEHIND
FEEDBACK SYSTEMS
SURVEY RESULTS INDICATE THIS AS A MAJOR PROBLEM AREA

- COMMUNICATION LACKING BETWEEN DIVISIONS, DISTRICTS, ENGINEERING, CONSTRUCTION AND OCE
- MOST FEEL ENG FORM 3078 INEFFECTIVE
- RELUCTANCE TO COMMUNICATE FAILURES
- NO TIME TO DOCUMENT SUCCESSES
IV. EFFECTIVENESS OF PROCEDURES TO INTRODUCE NEW TECHNOLOGIES
**INCENTIVES* FOR USING NEW TECHNOLOGIES (IN DESIGN PHASE)**

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<tr>
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<td>COST SAVINGS</td>
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<td>PROFESSIONAL RECOGNITION</td>
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<tr>
<td>CUSTOMER NEED</td>
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* RANKED TOP TO BOTTOM, THE MOST COMMON TO LEAST COMMON RESPONSE
CORPS' "EFFECTIVENESS" OF INCORPORATING NEW MATERIALS AND METHODS WHILE STILL ASSURING THE CONSTRUCTION OF RELIABLE / LOW - MAINTENANCE FACILITIES

AS ASSESSED BY ENG. DIV

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$\bar{X} = 3.0$

AS ASSESSED BY CON. DIV

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$\bar{X} = 2.3$
INNOVATION IMPLEMENTATION COMPARISON OF TWO CASE STUDIES

$\Delta T$ = Time before lagging element will implement technology into general use and full economic benefits are realized

- Passive Solar Technology

Private Sector $\Delta T$ ~5 Years Corps of Engineers

Relative Time Scale

- Single Ply Roofing Technology

Corps of Engineers $\Delta T$ ~10 Years Private Sector

Relative Time Scale
CONCLUSIONS

1. NO INSTITUTIONAL FACILITATOR TO ADDRESS NEW TECHNOLOGIES

2. AD HOC SYSTEM NON-RESPONSIVE TO EFFICIENT TECHNOLOGY MANAGEMENT
   - POOR CORRELATION BETWEEN CEGS's AND CORRESPONDING MANUALS
   - TOO LONG TO REVIEW AND PUBLISH UPDATED GUIDANCE DOCUMENTS (EM'S, CEGS'S, TM'S, ETC.)

3. TOO FEW INCENTIVES; TOO MANY DISINCENTIVES FOR FOLLOWING THROUGH

4. INSUFFICIENT FEEDBACK ON FIELD EXPERIENCES
RECOMMENDATIONS

GENERAL:
A TECHNOLOGY MANAGEMENT APPROACH SUPPORTED BY AN ORGANIZATIONAL "TEAM" EFFORT

1. ESTABLISH AN INSTITUTIONALIZED FACILITATOR (WITHIN USACE) TO ADDRESS NEW TECHNOLOGIES
   - DEDICATED INDIVIDUAL/COMMITTEE
   - TRAINING/TECH TRANSFER PROCESSES
RECOMMENDATIONS

(CON'T)

3. ENHANCE INCENTIVES FOR INITIATING AND FOLLOWING THROUGH
   - GENUINE REWARDS TO INDIVIDUALS
   - CLEARLY DEFINED STATEMENT OF CORPS' GOALS AND PHILOSOPHIES
   - REMOVE DISINCENTIVES
RECOMMENDATIONS

(CON'T)

5. ACQUIRE/PROVIDE COMPLETE AND ACCURATE INFORMATION
   - LIAISON WITH BUILDING INDUSTRY
   - SYSTEMATIC APPROACH TO INFORMATION
   - TTTB/FTAT/USER GROUP COORDINATION
   - "USER FRIENDLY" MECHANISMS/MEDIA
   - PROVIDE INFORMATION IN TIMELY MANNER
TECHNOLOGY ADOPTION INDEX (TAI)

• TO MEASURE EFFECTIVENESS OF ADOPTING NEW BUILDING TECHNOLOGIES

• COMPOSITE OF FACTORS MUCH LIKE COST OF LIVING INDEX

• BENEFITS:
  A. INFORMED RESPONSE TO INQUIRIES RELATIVE TO USACE's USE OF NEW TECHNOLOGIES
  B. IDENTIFY AREAS WHERE RESPONSIVENESS TO NEW TECHNOLOGIES OUGHT TO BE ENHANCED
28 September 1988

DRAFT

CETAP

CORPS OF ENGINEERS TECHNOLOGY ADOPTION PROCESSES STUDY

CONCLUSIONS AND RECOMMENDATIONS

By

R. G. Lampo

T. R. Napier

US Army Construction Engineering Research Laboratory
PO Box 4005
Champaign, IL 61820-1305
INTRODUCTION

Many of the processes used to identify, assess, and incorporate cost effective alternate technologies into US Army Corps of Engineers (USACE) practice are ad hoc. Accordingly, it is difficult to accurately assess USACE performance in adopting these technologies. Given the enormity of the Army's installation infrastructure and the comparatively small and totally inadequate funding available to modernize and maintain it, only aggressive identification, development, exploitation, and adoption of new technologies offers the Army any hope of staying even. The Corps of Engineers Technology Adoption Process (CETAP) Study was initiated to address these issues and make recommendations on how to improve the Corps' utilization of newly available construction technologies.

The CETAP Study consists of three main tasks:

Task 1: Compile an inventory of current mechanisms used throughout USACE for technology adoption.

Task 2: Develop a USACE technology-based point of contact (POC) list, establish a USACE technology adoption benchmark, and assess the USACE technology adoption systems relative to the benchmark.

Task 3: Use CETAP findings to shape development of the Building Technology Forecast and Evaluation System, an RDT&E work unit. The direction
identifiable throughout USACE, as SOP in the programming, planning, design and construction of military and civil facilities.

2. The existing ad hoc system is nonresponsive to efficient technology management in that:

   a. It takes too long to draft, review, and publish updated engineering and construction guidance documents.

   b. It has produced poor correlation between the Corps of Engineers Guide Specifications (CEGS) and corresponding engineer manuals (EM) and Army technical manuals (TM). EMs and TMs may be many years behind the information in the CEGS.

   c. It has "triggers" to initiate a review and update of CEGS, but the "triggers" to review and update TMs, EMs, and other engineering guidance documents are not in synch or operate on a completely ad hoc basis.

   d. It does not include mechanisms for appropriate technical and feasibility review of new technologies--the foundation of technology management.

3. The existing ad hoc system does not foster efficient technology management as it does not provide incentives to encourage the initiation and follow through on potential applications of new building technologies. Corps personnel reflect high levels of professional integrity and initiative, and
beneficial technology or may "reinvent the wheel"--including the bad experience--because of lack of shared information.

5. The existing ad hoc system does not provide sufficient and complete performance information on new building technologies in a timely fashion. Absence of a cohesive technology management approach inhibits the FOAs and HQ from adopting a new technology as soon as possible; the risk associated with its first use is too great. Lack of information implies a risk. Many times the information is available that may reduce the perceived risk to an acceptable level (in particular where a failure would not pose a safety threat). However, if the information is not available to the appropriate USACE or A/E personnel, or if it is not easy to obtain, project schedules/conditions inhibit the effort to acquire the information that would reduce risk.

6. The existing ad hoc system does not accommodate to the time and effort and review procedures required on a project-specific basis to facilitate the adoption of new technologies within the constraints of the project schedule. As mentioned above, the project schedule may not allow the time to collect the needed information in order to bring the risk to an acceptable level. Also, the time needed for higher level reviews may not be available. Reliance on the "status quo" is all that is generally allowed. A system of efficient technology management must address this practical problem. For example, several field personnel expressed the opinion that in most cases the local office or District personnel were capable of technically evaluating and approving the use of alternate technologies without higher level reviews; an
technology transfer issues. Facilitating the training, i.e., the educating the FOAs regarding the regulations, policies, and procedures for adopting new technologies would be another important responsibility. The "new technologies facilitator" could be implemented in one of several ways, such as:

- Create a single office at the HQUSACE Engineering and Construction (E&C) Directorate level (similar to the current Value Engineering Office at HQ). This office would rely on technical input and support from resources both within HQ USACE, the National Teams, Technology Centers of Expertise, and the Laboratories.

- Establish a Technology Advancement Steering Group representing the technology disciplines within E&C. It would be chaired/directed by a senior level person from within the current E&C resources. This group would receive input from the National Teams and Technical Centers of Expertise and be a decision-board on facilitating the use of advanced technology.

- Designate a "New Technology Facilitator Group" from within the National Teams. This group would be chaired/directed by one of the Team chairpersons, and maintain close interaction with the technical disciplines (i.e., Branch Chiefs) within HQUSACE E&C Directorate. This group would present recommendations to the Director of Engineering and Construction.
for TMs, EMs, and other associated documents. Where these other documents are outside of USACE jurisdiction, or follow different cycles for revisions, guidance should be developed to indicate how these documents should be observed. Proponents of CEGS normally have a tracking system within their own organization for reporting status to upper management. Instead of establishing another tracking system, it could be a comprehensive, E&C-wide project management approach to the review/publish process.

- Assign the project managers the prime responsibility for developing a process to reduce the technology gap that currently exists between the CEGS and the corresponding Manuals (EMs and TMs). This is probably the most pressing improvement needed in this area.

- Develop a comprehensive information feedback system that will better assist HQ USACE Branch Chiefs and Huntsville Division personnel in their technical reviews of new technologies and considerations for CEGS modifications. The information system development and management could be responsibilities of the Laboratories.

- Ensure that new technology items that originate from all sources are given prompt and appropriate consideration. Draft design and construction guidance (CEGS, EMs, etc.) should be developed and sent to Huntsville Division for further action immediately upon successful demonstration of new technologies in the various TTTB and
identifiable model for USACE personnel at all policy, management, and technical levels; i.e., a "team approach." The statement should clarify USACE objectives of achieving economic and performance advantages available from new technologies. It should also reinforce USACE quality objectives through pursuit of new technologies in a calculated manner to avoid undue risk. To better ensure uniform practice a single Engineering Regulation should provide guidance to FOAs on how to accomplish the stated goals.

- Provide individuals with incentives to champion new building technologies. Reward project personnel on a project specific basis where adoption of a new technology has resulted in a higher quality project delivered on time and under cost (such as decreased life cycle costs, enhanced performance, more rapid construction, etc.). Also provide individuals with incentives to champion new technologies that will improve the productivity and efficiency of resources in providing military facilities on a general basis.

- Encourage professional and personal initiative by removing the disincentives to consideration of new building technologies. Provide complete and timely technical information on new technologies to reduce the perceived risks involved with first-time uses, as well as to enable the evaluation of new technologies within project schedules. Allow reasonable flexibility in project schedules to permit the exploration of technology alternatives with the potential of overall project advantages; ensure personnel keep
effective feedback process will do much to expedite the general use of successful new technologies as well as add to the database on performance expectations and maintenance requirements. This information must be readily accessible to project management and design personnel to be useful on a project-specific basis.

- Establish a comprehensive system for feedback information requirements and provisions. Maximize the use of information available from field/construction experiences and disseminate it to all appropriate USACE offices. Encourage the use of Engineering Form 3078 through appropriate incentives or inclusion in Performance Standards. Include issues other than "deficiency reports" on 3078s, such as experience with a new technology, recommended applications, or sources of information. Prevent negative impacts resulting from the submittal of negative experiences or failures, if such occurrences were not the result of negligence or inappropriate use of the technology.

- Expand the use of sources of feedback information currently available to USACE. The Value Engineering Retrieval Program (VETRIEVAL) is one such source. The VE experiences are logged and filed but are not readily known other than among those directly involved. A great many ideas and potential lessons learned are also acquired at the construction site. Collection of this construction expertise must be encouraged, and the information must then be used in design development on a project-specific level. Dissemination of
Establish a systematic approach to information acquisition and management. The five-step (technology transfer) process involving the National Teams is an important piece of the process. The information must be complete, accurate, and up-to-date on all new technologies emerging in the construction marketplace. This information should be readily accessible and obtainable in a timely manner by those who need it. Assign specialists in technical areas throughout USACE (i.e., "gate keepers") the responsibility of the database on what's-being-done-where (i.e., they must be knowledgeable and keep up-to-date with developments in that area). Maintain association with the appropriate professional and industry groups. It is critical that the individuals involved be knowledgeable and energetic advocates ("champions") for the advancement of technology in their specialty area. They should be encouraged to be chairpersons of appropriate technology-based user groups.

Develop an "effort sharing" approach with industry for the acquisition of information on new building technologies. Involve proponents of new technologies with generating and providing the necessary information that will enable USACE to judge a technology's suitability.

Identify the critical information requirements at the different USACE levels relative to the preparation of CEGS and manuals for new construction as well as project specifications for facilities maintenance. Package information at levels appropriate for the
resistance to new technologies that arises from lack of information about operating expertise, spare parts inventories, maintenance activities, etc. Training seminars may also be necessary to prepare the user to implement the new technology and to help maximize its capabilities. Maintenance feedback must be called for in order to start a history file on performance reliability that would feed back into the document review and update cycle.

- Ensure the accessibility and effectiveness of the information mechanism and media; information will be of no use unless it is "user friendly". Ensure efficiency in information retrieval; i.e., easy access to the specific information needed within the time constraints posed. Address policy and practice relative to information, such as opportunity and responsibility for consolidating information sources and systems.

- Support the adoption of new technologies through the Construction Productivity Advancement Research (CPAR) Program. Involvement in CPAR activities by USACE Laboratory personnel should include acquisition and dissemination of information on the technologies promoted through CPAR work.

A current action of interest regarding an information system on new technologies is being conducted at Georgia Tech University. They have been contracted by the Corps of Engineers National Alternate Construction Technology Team (CENACTT) to develop a concept plan for the establishment and
CERAMIC ANODES FOR CORROSION PROTECTION

The Problem

Corrosion of metallic structures buried in soil or immersed in water can be stopped by cathodic protection—applying a small electric current from an outside source to the corroding structure. The current is applied through an anode, which eventually is consumed in the process by the current. The anode is the positive terminal in the corrosion battery, and the structure is the negative terminal (as in a flashlight battery where the center of the battery is positive and the casing is negative).

For the past 30 years, primarily two materials—silicon-iron and graphite—have been used in the cathodic-protection anode. However, these materials are brittle and have consumption rates on the order of one pound per ampere year; i.e., if one ampere of current is passed through the anode for one year, one pound of the anode will be consumed. Consequently, large anodes were required, which made the anode vulnerable to debris/ice damage and also prone to field installation problems which led to numerous electrical shorts in the system. This has reduced the reliability of the cathodic protection system in the Army Corps of Engineers to an average of 20 percent.

The Technology

Corrosion research at USA-CERL is concentrated on cost-effective methods for combating corrosion in the high-volume, low-cost materials used in Corps of Engineers activities. A USA-CERL-developed breakthrough in cathodic protection is the ceramic anode. The ceramic anode is an alternative to the silicon-iron and graphite anodes. The ceramic anode makes corrosion protection available at one-half the life cycle cost of previous technologies and in a size reduction that permits installation in areas previously too small. One ampere of current supplied to the ceramic anode will stop corrosion on 500 square feet of uncoated steel.

The consumption rate of conducting ceramic materials such as metal oxides is 500 times less than the currently used silicon-iron and graphite anodes. This resulted in an anode that is much smaller (50 times by weight) and has the same life. The ceramic anode also has a factory fabricated and tested redundant electrical connection which eliminates installation problems associated with silicon-iron and graphite anodes and results in positive electrical isolation between the anode and the structure. In addition, the
CONSTRUCTION RESEARCH CENTER
GEORGIA TECH SUPPORT TO CENACTT

• Coordinate/Host two CENACTT meetings
  – Prepare minutes

• Design/Edit/Publish two CENACTT newsletters
  – Semi-annual
  – 8-10 articles
  – 6-8 pages
  – 300 copies

• Develop plan to coordinate CENACTT efforts with CPAR program

• Concept to establish/maintain a Corps Technology Transfer and Information Center
  – Individual files/spreadsheets/accounts
  – Access to library databases
  – Access to Corps-sponsored databases
  – Electronic mail system throughout the Corps
COLLEGE OF ARCHITECTURE
GEORGIA INSTITUTE OF TECHNOLOGY
CONSTRUCTION RESEARCH CENTER

A NATIONALLY-RECOGNIZED RESEARCH FACILITY TO SUPPORT U.S. INDUSTRY IN ALL ASPECTS OF CONSTRUCTION TECHNOLOGY.
WHAT'S WRONG IN THE U.S. CONSTRUCTION INDUSTRY?

- A FRAGMENTED AND DIVISIVE INDUSTRY
- EFFICIENCY/PRODUCTIVITY RAPIDLY DECLINING
- RESTRICTIVE BUILDING CODES AND TECHNICAL STANDARDS
- POOR MANAGEMENT AND LABOR PRACTICES
- RESEARCH AND NEW TECHNOLOGY IS DISCOURAGED
- LOW FUNDING OF UNIVERSITY RESEARCH
- POOR TRAINING AND EDUCATION PROGRAMS
- VERY POOR TECHNOLOGY TRANSFER MECHANISMS

MISSING ELEMENTS IN THE CONSTRUCTION INDUSTRY

- Identification of NEEDS
- Link Between NEEDS and RESEARCH
- Link Between RESEARCH and APPLICATION
<table>
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<tr>
<th>COUNTRY</th>
<th>T² PERIOD (YEARS)</th>
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<tr>
<td>JAPAN</td>
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</tr>
<tr>
<td>WEST GERMANY</td>
<td>5.2</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>7.4</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>7.7</td>
</tr>
</tbody>
</table>

GEE; Technology Transfer, Innovation and International Competitiveness; 1981.
GOALS

1. Provide U. S. Industry with a Focal Point for:
   - Construction Technology Research
   - Information Exchange

2. Conduct an R & D Program Responsive to the Needs of the Construction Community

3. Disseminate Research Results through a Vigorous Technology Transfer Program
   - In-House Research
   - Out-Of-House Research
CONSTRUCTION RESEARCH CENTER
FIVE-YEAR PLAN

TECHNICAL ORGANIZATION

- CONSTRUCTION RESEARCH LABORATORY
- TECHNOLOGY TRANSFER DIVISION
- CONSTRUCTION TECHNOLOGY INFORMATION CENTER
  - GEORGIA TECH LIBRARY
- EDUCATION AND TRAINING PROGRAMS
  - GEORGIA TECH EDUCATION EXTENSION
GEORGIA TECH EDUCATION EXTENSION SERVICES

- Offers 800 courses (Scientific/Technical/Professional)
  - On campus/off-site instruction
  - Live television satellite feed
  - Video-based instruction

- Specialized Training
  - Institute of Planning/Operational Analysis
  - Language Institute
  - Software Training Facility

- During 1987, conducted courses in 129 U.S. cities and 9 foreign countries

- Ranked the best Continuing Education Program in the U.S.
CONSTRUCTION RESEARCH CENTER
SUPPORT TO THE TECHNOLOGY TRANSFER PROCESS (CONTINUED)

- Commercialize existing new technologies

- Technical Assistance Programs
  - Toll-free telephone service
  - Technical experts to answer inquiries
  - Recorded messages on construction technologies

- Conduct a dynamic education and training program
  - Exploit GT Education Extension capabilities

- Sponsor new technology meetings/workshops/conferences
Productivity is lagging, market share is shrinking, and the Japanese are working in our own backyard.

JOHN H. WIGGINS

The United States construction industry is ailing, experiencing a decline that rivals that of the auto and other U.S. manufacturing industries. In the 1960s, construction made up 10.6% of the gross national product (GNP)—now, that’s down to 8.7%. The reduction is alarming to a number of people in the private sector and is now being taken seriously by the federal government. The decline can be traced to a host of reasons, including a drop in productivity, the shrinking worldwide market share and the emergence of the Japanese.

How the decline is to be halted and reversed is a subject that several committees are continuing to address. In 1986, the Building Research Board of the National Academy of Science funded a committee to report on the problem. ASCE was funded $90,000 to prepare a report for the National Science Foundation that will present a theme for future civil engineering construction. That report is in review and should be made public next month.

An examination of the reasons behind the decline may be the first step to reversing it, and one of the main reasons is the drop in productivity. Despite the improvement in construction tools and equipment (such as computers), despite the relative parity in labor costs over the last 30 years, and despite other cost cutting measures, the output per employee hour has dropped markedly. Productivity of those employed by construction rose steadily from 1947 to a peak level in 1968. Since 1968, however, output has decreased to the same level achieved in 1957.

A comparison of the construction industry to other industries reveals the same malaise (Fig. 1). Communications, for example, has experienced a 5.28% annual growth rate since 1947. Agriculture has shown a 4.68% increase; utilities, a 4.18% increase; wholesale trade, a 2.51% increase; and transportation, a 2.47% increase. Construction, meanwhile, comes in last on the list of ten industries, with an annual growth rate of just 0.47%—just one-third the rate of services, the ninth rated industry.

Construction's decline can be traced to other reasons. For example, there are about 1 million general and specialty contractors in the U.S., as well as 50,000 architect and consulting engineering firms. There are more than 25,000 building material dealers and 15 major building and construction unions. Constraints—environmental, ecologic, economic—surround every project built. Bureaucratic foot-dragging, a proclivity of all governmental bodies, restricts construction. And, the increase in errors and omissions and product liability suits further hinders construction.

The fragmented nature of the industry coupled with the complexity of our society and the perceived need to sue everyone in sight has caused delays and increased expenses. Further, the delays have caused a greater proportion of construction costs to be produced by interest payments, while the same time interest rates have skyrocketed. The situation doesn’t seem brighter in the international marketplace.

THE JAPANESE WAY

Understanding the emergence of Japanese firms is made easier by examining their practices. For example, Japanese engineering and construction firms are required to put 1% of their gross receipts into research and development aimed at products or procedures five years down the road. Furthermore, they involve their directors of research in all their marketing and major sales efforts. The researchers join the sales people in meetings with potential clients.

One typical Japanese firm is the Shimizu Construction Company. R&D personnel comprise 16% of the professional staff and they have out-of-house relationships with many more R&D personnel. Shimizu is also funding many R&D programs, such as intelligent buildings, factory automation, earthquake systems, robotics and environmental control systems. Anticipatory needs, such as the decommissioning of nuclear power plants, are also being given much attention.

FIGURE 1
LABOR PRODUCTIVITY GROWTH

<table>
<thead>
<tr>
<th>Industry</th>
<th>Growth Rate</th>
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<tbody>
<tr>
<td>Communications</td>
<td>5.28%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>4.68%</td>
</tr>
<tr>
<td>Utilities</td>
<td>4.18%</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>2.51%</td>
</tr>
<tr>
<td>Transportation</td>
<td>2.47%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.47%</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>1.75%</td>
</tr>
<tr>
<td>Finance, Insurance</td>
<td>1.49%</td>
</tr>
<tr>
<td>Real Estate</td>
<td>1.34%</td>
</tr>
<tr>
<td>Construction</td>
<td>0.47%</td>
</tr>
</tbody>
</table>

Source: Bureau of Labor Statistics

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High-Tech Industry Isn't Likely To Rescue Economy, Panel Warns

The Associated Press

WASHINGTON — The belief that America's economic standing in the world will be rescued by emerging high-technology industries was questioned Wednesday by a prestigious study group that said the country is fast losing its dominance in many of those fields.

The Council on Competitiveness, contending that the country has been far too complacent in the face of growing foreign competition, recommended a major effort on the part of government, industry and schools to reverse the trend.

"We cannot afford any further erosion in our once-commanding technological lead," said the report of the council, composed of 151 top officers of industry, labor and higher education. "Because technology is a driving force behind productivity improvements, export strength and a high standard of living, the stakes are enormous," it said.

In releasing the report, John Young, chairman of the council and resident of Hewlett-Packard Co., said he wanted to challenge the comforting illusion that high-technology industries would provide the economic panacea we all need" to offset job losses in traditional smokestack industries.

"In 1987, our trade deficit with Japan in electronics was almost as large as it was for automobiles. So Silicon Valley is not so far removed from Detroit," he said.

The report, speaking for U.S. companies' market share that had shrunk so dramatically over the past two decades that the country suffered a trade deficit in high-technology goods for the first time ever in 1986.

The Council on Competitiveness said that between 1970 and 1987, American manufacturers' share of the U.S. market for record players fell from 90 percent to 1 percent, for color televisions from 90 percent to 10 percent and for telephones from 99 percent to 25 percent.

Citing government statistics, the report said that between 1970 and 1987, American manufacturing companies saw their proportion of the U.S. market for record players fall from 90 percent to 1 percent, for color televisions from 90 percent to 10 percent, for machine tools from 100 percent to 35 percent and for telephones from 99 percent to 25 percent.

"In field after field ... foreign competitors have moved into markets pioneered and once dominated by American firms," the council said. "Often their success was built on exploiting inventions made in American laboratories by American scientists."

The report said countries such as Japan have done a much better job of bringing new technology to the marketplace quickly.

"We've been too slow, too fragmented, too uncoordinated and too adversarial," said Bobby Inman, a member of the council and the chairman of Westmark Systems Inc.

Roland W. Schmitt, president of Rensselaer Polytechnic Institute, said, "At the same time we are slipping downward in our ability to compete with foreign nations in high-technology product sales, we are slipping into dependence on foreign nationals to sustain education and research efforts."

He said that in U.S. engineering schools, 40 percent of the students and one-third of the faculty are foreign-born. Even this infusion of talent will not be enough to prevent an estimated shortage of 500,000 scientists and engineers in the country by the year 2010, the report said.

Mr. Schmitt said the decreasing interest of American students in math and science was caused in part by a generally lackluster quality of teaching at the high school level.

To correct these problems will require increased federal spending, even in this era of tight budgets, the report said.

Among the council's recommendations:

- The president's national science adviser should be elevated to Cabinet rank with the power to develop a presidential strategy for the development of science and technology.
- The federal government, which spends as much on research and development as all of American industry combined, should concentrate more on commercialization. The report said the current priorities of defense, space, energy and health are focused too narrowly.
- Federal spending to support university research should be increased, with $10 billion needed over the next 10 years to upgrade university research facilities.
Report on Demonstration Project
Roller Compacted Concrete Paving
Fort Benning, Georgia

Prepared by SAS
1 November 1987
Department of Defense AI-Robotics Database Available to Qualified Users

The Robotics/Artificial Intelligence Database (RAID) is a comprehensive, organized information base for all defense-sponsored efforts in robotics and AI technology. The largest of its kind in the United States, RAID's development and use by members of the A&R community is being encouraged by C-STAR.

RAID was developed and managed by the Naval Ocean Systems Center (NOSC), in San Diego. It is funded by the Defense Advanced Research Projects Agency (DARPA) and the U.S. Army and the Marine Corps, as well as the Navy. RAID has been approved and adopted by the Joint Technology Panel for Robotics, formed by the chairman of the Joint Directors of Laboratories.

NOSC was selected to develop RAID because of the Center's active programs in both robotics and artificial intelligence, telecommunications, and database systems. This environment provides the RAID staff with ready access to the technical expertise required to maintain the integrity of the data and to oversee the communication network. It also provides access to advances in database technology.

RAID is accessible through MILNET, the DoD's communications network. It is installed on a VAX-11/780 computer under the 4.3bsd UNIX operating system. Management is by the NGRES relational database system, which was selected because of its simplicity and flexibility, as well as the degree of data security required. RAID can be accessed by an on-line menu system, providing easy searches and report generation. As an added benefit, RAID users may take advantage of the NOSC electronic mail service.

RAID is operated for NOSC by Computer Sciences Corporation, San Diego.

RAID Contents

RAID is designed to support both the manager and the researcher in robotics and AI. Its information is gathered from and verified by a variety of sources, including DD-1498 forms provided to the RAID staff by the Defense Technical Information Center, summary documents, and personal communication. It contains three kinds of information:

- **Projects**—a description of research (both an abstract and a classification), responsible organization, and other identifying information.
- **Financial/contractual**—further expansion on the organization conducting the research, starting and ending dates, and funding information.
- **Contacts**—address, phone number, interest areas, and electronic mail address of individuals and organizations involved in robotics/AI R&D.

Users can select and combine information to meet their needs. And the RAID staff can also tailor report formats to meet the requirements of individual users. A sample of a RAID search is shown on page 6.

Searching RAID

The database has two major kinds of search categories—applications and technology keywords. NOSC chose this structure because a number of technologies are being developed within a project that could be used on other projects and each project has a specific application to which it is directed, even if it is basic research. The user can perform a matrix search for all projects having one or more keywords within a single application. The user receives printed lists of the application categories and the technology keyword categories.

RAID offers the following services to U.S. government personnel and those contractors having a government sponsor or endorsement:

- **Off-line searches and reports**, including special report formats and complicated search criteria
- **On-line access**, allowing the user to view all data directly, search with user-created criteria, display the results on a terminal, and generate reports on-site
- **Electronic mail**, providing access to other researchers in the field

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CONSTRUCTION PRODUCTIVITY ADVANCEMENT RESEARCH

BACKGROUND:
Levels of construction research and development (R&D) spending over recent years, both by government and private industry, have been deficient. The result has been a loss of competitiveness by the American construction industry, not only in this nation but abroad.

Advancing construction productivity would reduce federal construction program costs, and projects not now economically feasible might become feasible due to lower construction costs. Cost savings would accrue directly to the federal government's construction program as well as benefit the construction industry and the U.S. economy in general.

NEEDS:
- To reverse declining construction productivity in the U.S.
- To improve competitiveness of the U.S. construction industry at home and abroad
- To reverse trend of low construction R&D investment to promote long-term stability of the U.S. construction industry
- To assist the U.S. construction industry in incorporating advanced technology into daily practice
- To effectively transfer federally developed construction technology to the U.S. construction industry

BENEFITS TO:
- National economy
- National defense posture
- Construction industry and its users
- Government at all levels
- U.S. Army Corps of Engineers' mission programs
MAJOR PROGRAM AREAS

DESIGN IMPROVEMENT:
- TOTAL INTEGRATED DESIGN SYSTEMS
- COMPUTER-AIDED ENGINEERING TOOLS
- COMPUTER-AIDED DESIGN SYSTEMS
- ADVANCED SITE INVESTIGATION TECHNOLOGY
- KNOWLEDGE-BASED COST SYSTEMS
- EXPERT SYSTEMS/ARTIFICIAL INTELLIGENCE
- MATERIALS SELECTION SYSTEMS

IMPROVED CONSTRUCTION SITE PRODUCTIVITY:
- COMPUTER-AIDED CONSTRUCTION
- AUTOMATED CONSTRUCTION/ROBOTICS
- AUTOMATED INSPECTION-AND QUALITY CONTROL
- ADVANCED EXCAVATING AND TUNNELING
- MARINE CONSTRUCTION
- COLD WEATHER CONSTRUCTION
- CONSTRUCTION MANAGEMENT
- EXPERT SYSTEMS
- MATERIALS HANDLING

ADVANCED MATERIALS:
- HIGH-PERFORMANCE CEMENTITIOUS MATERIALS
- STRUCTURAL POLYMERS
- ADVANCED CERAMICS
- METAL MATRIX COMPOSITES
- COATINGS
- GEOMODIFIERS/GEOTEXTILES
- ADHESIVES/FASTENERS

TECHNOLOGY TRANSFER MANAGEMENT:
- USER-BASED TECHNOLOGY TRANSFER PROCESS
- FIELD DEMONSTRATION PROJECTS
- TECHNICAL SUPPORT SERVICES
- PATENTS AND LICENSING AGREEMENTS
- SOFTWARE PACKAGES
- COURSES AND WORKSHOPS
- INFORMATION EXCHANGE SYSTEMS
- PARTICIPATION WITH SPECIFICATION AND BUILDING CODE ORGANIZATIONS
- COOPERATIVE R&D AGREEMENTS
Laser Printers Arrive

*Speedier, Less Costly Laser Printers Are Changing the Computer Business*

As laser printers gain more attention with lower prices, higher speeds and quality output, high-end dot-matrix printers are starting to lose some of their appeal.

Though PC users are still buying dot-matrix printers, the laser printer is giving them an alternative to think about, according to industry observers.

Laser printers, though relatively expensive, are becoming used more in networked environments where the distributed use of the printer justifies the expense, several analysts said. The non-impact printers also catch user interest because they are less noisy, offer sharper graphics (commonly 300-by-300 dots per inch) and can produce from eight to 10 pages per minute.

Competing Technologies

- Daisy Wheel
- Dot Matrix
- Laser printers
- Laser printers with write-white engines and copier options, using dry powder toner.

Laser printers still have a few areas that could be improved, according to George Jones, a key industry analyst. He noted that there are no standards in controllers for laser printers and the cost of using a laser is now less than a dot matrix on a cost-per-copy per minute basis.

The laser printer provides sharper graphic images, Jones noted, and the laser now has the wealth of software support dot-matrix printers have always enjoyed. So, if a user moves to a laser printer from a dot-matrix printer he can run much of his graphics software and get better graphics resolution, Jones said.

The next step is developing generic graphics drivers which support lasers at 300-by-300 resolution. That's when you will see a huge impact on dot-matrix printers, both in price and the number of units shipping, he said, adding that it will be a year to 18 months before this happens.

Jones was quick to point out that he never sees dot-matrix printers disappearing. Multiple-part forms are still important, and an impact printer is needed for that. He also noted that people will always want hard copies for their files or interoffice memos, and the quickest, most cost-efficient way of doing that is through a low-cost dot-matrix printer without having to wait in line for a share laser printer. Current sales figures seem to bear Jones out. In its June 1985 Store Board Survey, market-research firm Laser Computing of Alamo, Texas, polled over 600 computer specialty stores finding that, while laser-printer sales are up, they have not eclipsed dot-matrix printers.

Laser Computing analyst Todd Wiggins said he expects dot-matrix printers to continue competing with laser printer in the future. He also said the two technologies can work well together. If you've got a laser shared by six to 10 people, you may still have dot-matrix printers for drafts of your own work. I think there's room for both [types] for a while, he said. As the prices of laser printers fall, more PC users may choose them over dot-matrix printer. Wiggins said the current value of the laser-printer market is about $450 million, expected to grow to about $2.2 billion by 1990.

Bill James product marketing manager with Acme Hardware which produces impact as well as non-impact printers, said both have a category in which they're most
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\[
\text{Total} = 760-810
\]
Physical Security

EMP Shielding

CENACTT
Types of Technology

Pavements

Building Systems, Processes and Products

Corrosion Evaluation & Protection
1. **Mission.** CENACTT was established to:

1. To test alternate products and processes which reduce construction, operation, and maintenance costs of military facilities while maintaining equal quality in construction and operation and which are consistent with current design, construction, and operation practices.

2. To formulate and implement a comprehensive, cohesive strategy for introducing new building technology into the construction process and promoting its spread in the minimum practical time.

**CENACTT INCLUDES:**

1. Innovative results of R&D (state-of-the-art) for technology transfer.
2. Emerging commercial products for technology transfer.
3. Proven products in new applications.

The CENACTT team is an advisory group to the OCM proponent. Organizational authority is delegated to the lead division.

Technology transfer concerns itself with proven products and processes and state of the art R&D products and processes. Regarding the R&D effort, the technology transfer is to occur at the point that the process is proven practical and basic R&D is complete. The evolution of a process moves from Need, to R&D, to Demonstration, to Documentation, to Use. The technology transfer process picks up at the end of the R&D stage.

Technology transfer is complicated in the districts and divisions by an emphasis on quality and schedule and the attitude by users that they do not want any problems with the end product, even if the process is new and needs refinement. Top management needs to be actively involved and all parties involved need to be aware of the risk factors involved in technology transfer.

Strategies need to be developed for post-test marketing. It will be necessary to involve top management, provide incentives at the working level, and have communications between the designers and users to select potential sites. Marketing may include consultation and visits to promote and explain processes.
3. Functions & Technology Areas

a. The CENACTT shall review the on-going RD&E programs of the CE Laboratories in the field of construction technology in order to identify new and/or alternative technologies that may be ready for transfer and which may have wide application. The CENACTT shall also endeavor to identify new and/or alternate construction technologies developed outside the Corps which may have beneficial applications within the Corps's programs.

b. The CENACTT shall then select and prioritize those new and/or alternate construction technologies which appear to be most promising for support in the CENACTT program. The CENACTT will develop recommended funding levels needed for implementation of the CENACTT program.

c. CENACTT members shall help demonstrate and evaluate selected R&D products/systems. CENACTT shall help develop plans to promote and otherwise market promising products and technologies.

d. The CENACTT shall advise and assist CEEOC and CENSC-FM on the formulation, review and implementation of new and existing criteria and policy in the field.

CATEGORIES OF ALTERNATE CONSTRUCTION TECHNOLOGY:

| (1) Pavements                  | Examples |
| (2) Cathodic Protection        | Include industrialized (manufactured) building, underground construction, cathodic protection, EMP protection technology, alternate pavement systems, and fibrous concretes and reinforced soils. |
| (3) Shielding                  |          |
| (4) Cold Regions               |          |
| (5) Physical Security          |          |
| (6) Quality Control of the Design Process |          |
| (7) Building Processes, Systems & Products |          |

4. Coordination

a. Liaison members with other NT's

b. Joint funding of common projects (tests, etc.)
## BUILDING TECHNOLOGY

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Facility Technology Application Test (FTAT) Program 10/13/88

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From The Field

THE PAINT TEST KIT: Ensuring the Quality of Paint at Fort Riley, Kansas.

The high paint failure rate at Army installations is costly. Paint failure occurs when either contractors use substandard paint, or field personnel do not realize at the time of application that paint from on-base storage is not of suitable quality. The USA-CERL developed paint test kit is a portable test kit that can be used by field personnel to check the basic qualities of oil-based and latex paints. The kit is intended as a routine screening device; paints which do not appear to be equal to a standard should be sent to a testing laboratory for more sophisticated testing. The kit evaluates properties such as drying time, hiding power, appearance, gloss, adhesion, cleanability, and other basics.

In January 1986, 100 paint test kits were distributed to interested personnel in the Directorate of Engineering and Housing (DEH) at Army installations. DEH personnel were asked to use the kit routinely, and to send in records of their use to USA-CERL. The response by the users was extremely positive.

Don Story, an Inspector-DEH at Fort Riley, Kansas, routinely uses the paint test kit to check all paint used by contractors. "Using the kit," says Story, "is fairly simple. The book describes how to do everything." Story says he starts testing the paint while the contractor is actually painting. "The reason for this," he explains, "is to make sure we test the paint that the contractor is actually using. If we tested the paint before he started, he could give us some paint that he wasn't actually going to use." There are three waiting periods for results. The results from some tests are available the same day. Some are available the next day. The last set of results takes 6-7 days. Asked if that wait is a problem, Story replies, "Actually it's better since I only have to take an hour to do the test and then I can come back next week and take another hour to finish the tests." Story estimates that the total time he spends doing the tests, spread over several days, is two hours.

Though Story has not identified any bad paint through these tests, he still feels the tests have been worthwhile. "Because the contractors know we're checking, they are more apt to give us what we want," he says. Another advantage he adds is, "It's sometimes difficult to get the money to have paint tested. This way we can just test it ourselves."

The USA-CERL Paint Test Kit is on the General Services Administration's New Item Introductory Schedule and was assigned a GSA number. This facilitates the Army's ability to purchase the kit at a government-approved price from a sole source vendor. The kit is currently marketed by the Nucleus Corporation of Madison Heights, MI.
LISTING OF FACT SHEETS AND VIDEOTAPES ON FTAT DEMONSTRATIONS

If you would like to receive any of the following Fact Sheets or Videotapes on FTAT Demonstrations, please circle the number before the title and complete the address box on the back side. Then mail to:

FTAT Information Center
USA-CERL/ATTN: CECER-ZP
P.O. Box 4005
Champaign, IL 61820-1305.
COMM 217-373-7204
Toll-free 800-USA-CERL (outside Illinois)
Toll-free 800-USA-CERL (within Illinois)

FACT SHEETS

FTAT 1. The Facilities Technology Application Tests (FTAT) Program

Pavement and Railroad Technology Demonstrations
PR- 1. Pavement Recycling
PR- 2. Dustproofing Unsurfaced Roads
PR- 3. Pothole Patching Using Recycled Asphalt
PR- 4. Overlay of Pavements

DEH Management Demonstrations
MT- 2. DEH/District/MACOM Data Communication System
MT- 4. Service Writer Procedure for DEH Maintenance Shops

Building Technology Demonstrations
BT- 1. Protected Membrane Roofs
BT- 2. Airborne Roof Moisture Surveys
BT- 3. Automated RPMS Inspection Recording System
BT- 4. Corrosion Mitigation

Environmental Technology Demonstrations
EQ- 1. Training Area Maintenance
EQ- 2. Environmental Guidelines for Multi-Purpose Training Areas
EQ- 3. Methods for Evaluating and Ranking Army Training Land Capabilities
EQ- 5. Nutrient Film Technique for Waste Treatment
EQ- 6. Innovative Waste Treatment at Remote Sites - Composting and Aerated Vault Latrines

Energy Technology Demonstrations
ET- 1. Energy Conservation Retrofits for Standard Designs
ET- 2. Improved Thermal Efficiency of Existing Buildings - Fort Devens
ET- 3. Improved Thermal Efficiency of Existing Buildings - Fort Carson
ET- 4. High Efficiency Heating Unit Conversion
ET- 5. Control of Heat Losses from Underground Heat Distribution Systems
ET- 6. Energy Recovery from Wastewater Using Heat Pumps
Airborne Roof Moisture Surveys

Above: Helicopter with mounted scanner doing an aerial survey.

Below: Information from an infrared photo is drawn on airphoto of army roof.

PROBLEM: Early detection of wet roof insulation.

TECHNOLOGY: An infrared scanner mounted on a helicopter quickly surveys roofs for an Army installation.

DEMONSTRATION SITES:
- Fort Wainwright, AK — FY84, 85.
- Fort Richardson, AK — FY84, 85.
- Fort Greeley, AK.
- Fort Meade, MD.
- Tobyhanna Army Depot, PA.

BENEFITS: Roofs can be surveyed frequently and easily to detect small moisture problems before they result in expensive roof failures.
March 16, 1990

Mr. Paul A. Howdyshell
Engineering & Materials Division
U.S. Army Corps of Engineers
Construction Engineering Research Laboratory
Post Office Box 4005
2902 Newmark Drive
Interstate Research Park
Champaign, Illinois 61820-1305

Reference: Contract DACA 88-88-M-1443, CENACTT Planning Support

Dear Mr. Howdyshell:

Attached for your review and comment is the draft report, "A Concept Plan for a CENACTT Technology Transfer and Information Retrieval Center." This report is submitted to fulfill the requirements of Task 4 in the Scope of Work in the referenced contract.

After your review the Construction Research Center will make final corrections and reproduce and distribute the final report per your requirements.

If you have any questions on the attached draft report please contact me or the Principal Investigator, Ms. Julia Zimmerman (404) 894-8125.

Sincerely,

[Signature]

Louis J. Circeo, Ph.D.
Director, Construction Research Center

Enclosure

bc: Ms. Miriam A. Drake, LIB w/o Encl.
    Mr. W. Brown, OCA, w/o Encl.
I. Introduction

The Georgia Tech Library has been asked to submit a concept plan for a construction technology information service to support the U.S. Army Corps of Engineers National Alternate Construction Technology Team (CENACTT). The center’s primary purpose would be to provide more timely and efficient transfer of information related to new construction technology, and to retrieve information relating to existing construction technologies. Information of many types will be available from this single source to USACE users, with possible later expansion to other services’ personnel and, perhaps, to the construction industry in general.

II. Background.

John W. Fisher, Director of the National Science Foundation’s Engineering Research Center on Advanced Technology for Large Structural Systems, recently stated, "Without strengthening its knowledge base, our fundamental understanding of the behavior of structures, America’s construction industry may be courting disaster -- while spending millions on repair and litigation. In fact, we are investing in the wrong end of the process ... spending millions of dollars in cures after the fact." 1

This statement emphasizes the importance of the transfer of information in any technology-intensive discipline. Information gives a competitive edge; reduces redundancy; describes results of previous work; creates an informed basis for decision making; and is a key factor in productivity. High-quality, readily available information can enable the U.S. to regain its lead in the construction arena.

The Georgia Tech Library and Information Center can provide customized information services that will improve the flow of information related to construction technology. Corps of Engineers personnel will have access to a vast range of high quality information, encompassing every aspect of the construction process: design, specification, standards, costing, codes, materials, environment, management.

III. Approach

It is recommended that the concept of a Technology Transfer and Information Retrieval Center be implemented in two phases. Phase 1 would be put in place utilizing existing Georgia Tech information systems and capabilities. It would be developed in conjunction with the libraries at the Corps Field Operating Agencies (FOA’s). Charges would be made on a per-use basis, either directly to the user or through a central USACE account. Phase 2 could be implemented on an optional basis, depending on the success of the Phase 1 program. It would include any additional Corps-specific requirements for which unique hardware, software, databases, etc. must be developed.

IV. Georgia Institute of Technology Library and Information Center

The Georgia Institute of Technology Library and Information Center is one of the leading technical libraries of the nation, with an outstanding collection of scientific and technical publications essential to the support of advanced study in science and engineering. Its holdings number over 1.6 million bound volumes, 900,000 technical reports, and 25,000 serial publications including journals, annual transactions and proceedings of scientific and professional societies in the U.S. and abroad. The patent collection of close to 4 million is the largest in the Southeast.

In 1962, the library was designated one of 12 Regional Technical Report Centers. The present collection, comprising reports of the AEC, NASA, DoD, and the National Technical Information Center, totals over 900,000 items. The library also maintains files of U.S. and foreign standards, vendor catalogs, specifications and product design information.

Since 1964, the library has been a depository for U.S. Government publications distributed by the Government Printing Office. It is also a map depository for numerous Federal and local agencies.

The GIT Library has access to over 400 online databases through the Defense Technical Information Center, Lockheed’s DIALOG, Systems Development Corporation’s ORBIT, Bibliographic Retrieval Service’s BRS, and both NASA’s and DOE’s RECON systems. Through these retrieval systems, the library has access to virtually all commercial open literature and DoD collateral level databases pertaining to both national and international scientific and technical literature and patents.

The Georgia Tech Information Services, a department of the Library, offers fee-based services to sponsored research users on campus and to individuals and businesses outside the Georgia Tech community. These services include literature searches, reports on specific subjects tailored to meet client needs, copying services, and loan services.
Phase I

The first phase in the development of a CENACTT Technology Transfer and Information Center would be the availability of a variety of existing information-related services through the Georgia Tech Library. The Phase I system would be developed to augment the current capabilities available in the individual FOA libraries located throughout the Corps of Engineers.

One of the primary resources is the Library's computerized catalog, a state-of-the-art information system providing access to one of the strongest collections of scientific and engineering materials in the U.S.

In addition, users would have access to Georgia Tech Information Services (GTIS), a unit of the Library. GTIS has been providing information to business, industry and government for twenty years.

The services comprising Phase I could be requested directly by the client on an as-needed basis. There is no capital outlay necessary for this or any other aspect of Phase I. Charges are based on incurred costs and staff time. Billing can be handled through monthly invoicing or deposit accounts.
1. Information Services Available through GTIS

The Georgia Tech Library has access to a mix of information technologies to provide a wide range of computer-based services. The trained staff of GTIS selects the best and most cost-effective methods to process each individual request. Examples of types of information which can be supplied are:

* Literature searches: The Library accesses over four hundred online data bases to provide bibliographies or lists of references on particular subjects. These include prominent engineering and construction data bases like BRIX, COMPENDEX, HAYSTACK, ICONDA, and more. Descriptions of these and many others are included in Appendix A. In addition, computer and software data bases, indexes to government information, patents, and standards and specifications are readily available.

* Numeric data: Government statistics and forecast information available in a variety of formats.

* Current Awareness: GTIS provides a current awareness service to keep users up-to-date on topics of interest.

* Quick reference: Prompt response to inquiries telephoned, FAXed, or E-Mailed. Typical needs are directory-type information and answers to brief questions.

* Document delivery: Copies of journal articles, patents, standards, specifications, and technical reports.

* Reports: GTIS will gather and summarize information and data and submit reports based on client needs.

2. Typical Search Results

In response to a user's request, GTIS prepares a package for the user. An example of a typical package is included here as Appendix B. The package can be FAXed, sent by express delivery or standard mail channels.
Phase II

1. Overview

The second phase in the development of a CENACTT Technology Transfer and Information Retrieval Center would be based on the success of the Phase I system. Information systems would be implemented on an optional basis, consistent with unique CENACTT requirements. The Georgia Tech Library would work closely with the libraries at the FOAs in order to augment, rather than duplicate, existing capabilities. Phase 2 would incur development and installation costs for Corps-specific hardware, software, data bases, telecommunications, etc. If a portion of these information retrieval systems are applicable to the U.S. construction industry, some of these costs could be defrayed or recovered.

An augmented CENACTT Technology Transfer and Information Retrieval system could include one or more of the following additional systems:

* Electronic mail and bulletin boards.
* Spreadsheet and CAD templates.
* Corps produced data bases of project reports, status reports, proposals, and other contributed information.
* Bibliographic and source data bases including the GT Library Catalog; government-produced data bases and commercially-produced data bases relating to construction technology.

2. Typical Phase II System Components

The system components of a CENACTT Technology and Information Retrieval Center would be modular and phased, allowing simpler functions to be implemented first, with more complex elements following when demand or capital permit.

The basic Phase II system could be premised on a Digital Equipment Corporation microVAX 3100 computer, running Ultrix, DEC's version of Unix. This operating system in and of itself would allow implementation of basic features such as electronic mail, asynchronous and Ethernet communication software, and file transfer capability. The configuration specified would allow up to 32 users to access the system simultaneously.

After system and Ultrix installation, application software may be added. For searching textual data bases, BRS/Search software could be used. BRS/Search would allow a great deal of flexibility in creating data bases and could be used for Corps-produced documents and reports. Numeric data may be addressed by the SPSS statistical software, or by loading tables of data into an Oracle data base for query via structured query language (SQL).
Both telecommunications access and bulletin boards could be facilitated by placing the system on the Internet. This is a nationwide data communications network with nodes at most universities and large corporations. A component of the Internet software, USENET, is designed to manage bulletin boards on a global scale and would be well-suited for that purpose in this system. A second plus for the Internet is that it provides an easy and high speed channel for file transfers and electronic mail between Internet nodes.

Access to the Phase II system for those lacking Internet facilities could be via 4 WATS lines at 2400 baud. However, 9600 baud modems could be employed if there are sufficient numbers of them at the remote locations accessing the system.

3. Typical Phase II Resource Requirements

If the phase II system components described above were implemented, the following resources would be required:

a. Hardware
   * 1 Digital Equipment microVAX III computer.
   * 16 megabytes of RAM.
   * 2 gigabytes of disk storage.
   * 1 8 port multiplexer.
   * 1 Ethernet card.
   * 1 high capacity 9-track tape drive for backup.

b. Software
   * Ultrix 3.2 operating system with 32 user key.
   * BRS/Search Unix version.
   * USENET bulletin board software.
   * Oracle relational data base management software.
   * SPSS statistical software.

c. Telecommunications
   * 4 WATS lines to allow free United States connections.
   * 4 2400 baud modems.

d. Software and hardware maintenance

Maintenance costs of hardware and software should be factored into the overall costs of the system.

e. Personnel

A minimum of one full-time employee would be required to man a hot-line, to be engaged in system operation, backup, problem analysis, software maintenance and data base creation and maintenance.
ADVANT
Type: Source (Textual-Numeric)
Subject: Construction Industry
Contains data on financing transactions related to the rent, lease, or purchase of construction and material handling equipment. Data are obtained from UCC1 forms used for reporting interest held in financed equipment.
Coverage: U.S. (contiguous 48 states and District of Columbia)
Time Span: 1981 to date

AGE
Type: Reference (Bibliographic)
Subject: Earth Sciences; Engineering
Contains approximately 40,000 citations, with some abstracts, to the worldwide literature on geotechnical engineering, with emphasis on Asian and developing countries. Covers geology and environmental aspects, site investigations (e.g., exploration, prospecting, sampling), soil and rock properties, soil and rock engineering problems, descriptions and case records of engineering works, construction methods, construction equipment and materials, and snow and ice mechanics and engineering.
Coverage: International
Time Span: 1973 to date

ARIANE
Type: Source (Textual-Numeric, Full Text)
Subject: Construction Industry; Standards & Specifications; Trademarks)
Contains information required by the building industry in these areas: (1) full text of materials on building technology and tools, including construction techniques for concrete, metal, and wood; thermal insulation; acoustics; waterproofness; equipment; and materials; (2) text of technical regulations and standards governing construction in France; and (3) building products, including information on 14,000 manufacturers, 140,000 trademarks, and 3500 families of products.
Coverage: Primarily France, with some data on other European societies and organizations represented in France

Time Span: Regulations, 1913 to date; trademarks and manufacturers, 1972 to date

AZtex HOTEL INFORMATION SERVICE

Type: Reference (Referral), Source (Full Text)

Subject: Construction Industry; Travel & Travel Industry

Contains information on the hotel and travel industries.

AZtex DAILY BULLETIN. Contains full text of AZTEX, a daily newsletter providing news of interest to hotel and hotel-related industries. Sources include wire services, electronic newsletters, public relations companies, newspapers, hotels, and travel organizations.

NEW HOTELS. Provides descriptions of new hotels under construction in the U.S. and Canada. Includes number of rooms, description of physical features (e.g., square footage of lobby, shape of building, construction materials used), estimated cost of construction, and contact name and address.

Coverage: Primarily U.S. and Canada, with some international coverage

Time Span: NEW HOTELS, current information; AZtex DAILY BULLETIN, current week

BATIMENT

Type: Source (Numeric)

Subject: Construction; Economics-France

Contains 3250 monthly and quarterly time series on housing construction and construction costs in France. Includes construction and construction cost indexes, as well as numbers of housing units authorized, under construction, and completed.

Coverage: France

Time Span: 1959 to date
BCIS On-Line

Type: Source (Textual-Numeric)

Subject: Construction Industry

Contains U.K. construction data, including costs for about 5400 items, about 18,000 price indexes, and related data (e.g., daywork rates, construction output, new construction orders). Cost analyses can be selected by various criteria (e.g., building function, floor area, location). Also provides news relevant to the construction industry (e.g., newly promulgated wage awards, economic indicators) and a guide to average building and element prices. Sources include government statistics and information supplied by BCIS users.

Coverage: U.K.

Time Span: 1973 to date, with 2-year forecasts

BODIL

Type: Reference (Bibliographic)

Subject: Construction; Engineering; Urban & Regional Planning

Contains approximately 70,000 citations, with abstracts, to Scandinavian literature on housing, planning, environment, building, construction, civil engineering, installations, energy savings, and alternative energy sources.

Coverage: Primarily Scandinavia (Denmark, Finland, Norway, Sweden), with some coverage (about 30%) of non-Scandinavian countries

Time Span: 1975 to date

BRIX

Type: Reference (Bibliographic)

Subject: Construction

Contains about 160,000 citations, with abstracts, to the worldwide journal, report and book literature on construction. Covers building research; construction problems and solutions in developing countries; electrical and mechanical engineering; energy conservation; environmental design; pollution; geotechniques; earthquakes; and structural engineering, design, properties, and performance.
Coverage: International
Time Span: 1970 to date, with some material from 1950

BVR (Building Commodity File)
Type: Reference (Referral)
Subject: Construction Industry; Products & Vendors
Contains information on about 50,000 building products currently available in Sweden and their 12,000 suppliers. Also covers about 15,000 discontinued products and their 2000 suppliers. Data for each product include trade name, brief technical description, product classification (e.g., heating systems, central heating systems, buildings), manufacturer, and general sales representative. Information is obtained from technical journals, daily newspapers, suppliers' literature, exhibitions, and surveys.
Coverage: Sweden
Time Span: Suppliers, 1975 to date; products, 1976 to date

BYGGFO (Ongoing Building Research Projects)
Type: Reference (Referral)
Subject: Construction; Research in Progress; Urban & Regional Planning
Contains approximately 2000 references to ongoing building research projects sponsored by the Swedish National Council for Building Research, the Swedish Institute for Building Research, and the Development Fund of the Swedish Construction Industry. Covers urban planning, housing, construction, and energy conservation.
Coverage: Sweden
Time Span: Current information

CANADIAN CONSTRUCTION (CANADATA)
Type: Source (Numeric)
Subject: Construction Industry
Contains over 1500 monthly time series covering over 30 categories of Canadian residential, commercial, institutional, industrial, and engineering (e.g., tunnels, dams, bridges) construction projects at the national and provincial levels. Includes number of projects, number of dwelling units, square footage (except for engineering projects), and contract value. Data are gathered through a network of reporters who contact architects, developers, property owners, building contractors, permit officers, and government agencies.

Coverage: Canada

Time Span: 1974 to date

CIM (formerly INTERCIM)

Type: Reference (Bibliographic)

Subject: Construction; Engineering

Contains about 25,000 citations to literature on water-based bindings including cement, concrete, lime, hydraulic binders, and plasters. Topics covered include technology, design, operations, maintenance, planning, experimentation, the environment, storage, shipment, and transportation related to mortars, plasters, resins, and composite materials. Also covers grinding and pounding, processing and treatment, and safety and security. Sources include books, theses, and conference proceedings.

Coverage: International

Time Span: 1969 to date

CIVIL ENGINEERING DATABASE

Type: Reference (Bibliographic)

Subject: Engineering

Contains about 35,000 citations, with abstracts, to the worldwide literature on civil engineering. Covers aerospace; air transport; cold regions; computer practices; construction; earthquake, environmental, geotechnical, and structural engineering; waterway, port, coastal, and ocean engineering; education; engineering mechanics; highways; hydraulics; irrigation and drainage; materials; pipelines; surveying; urban planning and development; and water resources. Sources include journals, books, and conference proceedings.
Coverage: Primarily U.S., with some international coverage

Time Span: 1975 to date

COMPENDEX (Computerized Engineering Index)

Type: Reference (Bibliographic)

Subject: Engineering

Contains about 1.8 million citations, with abstracts, to the worldwide literature (excluding patents) in engineering and technology. Fields of engineering include: civil, water, and waterworks, sanitary and waste, fuel, bioengineering, geology and mining, petroleum, metallurgical, mechanical, industrial, aerospace, automotive, marine, railroad, electrical, electronics and communications control, chemical, and agricultural. Related subject areas covered include construction materials, properties and testing of materials, transportation, pollution, ocean and underwater technology, nuclear technology, fluid flow, heat and thermodynamics, computers and data processing, light and optical technology, sound and acoustical technology, food technology, applied physics, instruments, measurements, and information science.

Coverage: International

Time Span: University of Tsukuba, 1969 to date; DIALOG, ESA-IRS, ORBIT, and STN, 1970 to date; CISTI, 1970 to date, with abstracts from 1982 to date; CEDOCAR, 1973 to date; Knowledge Index, 1975 to date; BRS, BRS/Colleague, Data-Star, and TECH DATA, 1976 to date

CORNET (Construction Information Online Retrieval Network)

Type: Reference (Bibliographic, Referral)

Subject: Construction; Construction Industry; Funding Sources, Contracts & Awards; Products & Vendors

Consists of 4 files of information on construction in Japan.

Kenzai. Contains information on construction materials available in Japan. Covers type (e.g., metal, fiberglass), purpose, specifications, manufacturers, and vendors.

Sakuhin. Contains citations, with abstracts, to articles on Japanese construction projects.

Yuushi. Contains information on financing available from
municipal and prefectural governments for commercial and residential construction projects. Includes amount, interest rate, and loan conditions.

Kouhou. Contains citations, with abstracts, to technical reports by general contractors. Covers applied engineering techniques for a variety of construction problems, including excavation and landfill, landslide prevention, tunneling, materials handling, noise prevention, and retrofitting of older structures. Provides name and purpose of technique, inventor, and description of application.

COUNTY BUILDING PERMITS

Type: Source (Numeric)

Subject: Construction Industry

Contains approximately 136,000 monthly and annual time series covering numbers of building permits issued and construction valuations for 5 types of residential structures. Also covers construction values for 6 types of non-residential structures. Data are available for all U.S. counties.

Coverage: U.S.

Time Span: 1972 to date

DEHEMA (DEHEMA Chemical Engineering and Biotechnology Abstracts Data Bank)

Type: Reference (Bibliographic)

Subject: Biotechnology; Chemistry; Engineering

Contains about 100,000 citations, with abstracts, to the worldwide literature in all areas of chemical engineering, biotechnology, chemical equipment manufacturing, chemical manufacturing, plant design and construction, computer-aided-design (CAD), mathematical models and methods, laboratory techniques, analytical chemistry, safety engineering, hazardous materials, pollution control, environmental protection, energy and raw materials supply and conservation, chemical reaction engineering, catalysis, unit operations, process dynamics and control, measurement, instruments, materials of construction, corrosion and corrosion protection, and operation materials.

Coverage: International

Time Span: 1975 to date
DODGE CONSTRUCTION ANALYSIS SYSTEM

Type: Source (Numeric)

Subject: Construction Industry

Contains about 4 million monthly time series for construction projects involving over 200 structural types. Data on contract value, square footage, number of projects, and number of dwelling units can be aggregated by region, time interval, and construction grouping. Data are obtained on a daily basis through a network of 1400 F.W. Dodge Division reporters who contact a number of sources, including architects, developers, property owners, building contractors, permit officers, and other governmental agencies.

Coverage: U.S.

Time Span: 1967 to date

DODGE/DRI BUILDING STOCK FORECAST

Type: Source (Numeric)

Subject: Construction Industry; Real Estate

Contains about 185,000 historical and forecast quarterly time series on U.S. buildings, including total square footage, number of buildings, and roof area for groups of structures in these categories: commercial, institutional, manufacturing, and residential.

Coverage: U.S.

Time Span: Earliest series from 1970, with 5- to 10-year forecasts

DODGE/DRI CONSTRUCTION MARKET FORECAST

Type: Source (Numeric)

Subject: Construction Industry

Contains about 1560 quarterly forecasts on U.S. construction activity. Covers footage and dollar value of awards for new construction, alteration dollar value, number of new dwelling units, and current and constant dollar values for 21 categories of residential and non-residential construction in the U.S. and 9 Census regions.
Coverage: U.S.

Time Span: 5-year forecasts, with historical series from 1970

DOMA (Dokumenntation Maschinenbau)

Type: Reference (Bibliographic)

Subject: Engineering

Contains over 460,000 citations, with abstracts, to the worldwide literature on mechanical engineering. Covers fundamentals of mechanical engineering; technical aspects of metals, compound materials, plastics, fuels, and lubricants; planning research and development, construction, and production; manufacturing processes; accident prevention; maintenance; machine damage; corrosion; tribology; data processing; user programs; measurement, testing, and control; mechanical components and devices; hydraulic and pneumatic systems; engines; process technology for mining, gas distribution, and water supply; machinery and tools; conveying techniques; industrial robots; heat technology; environmental engineering; printing technology; and precision engineering. Sources include periodicals, conference proceedings, patents, reports, dissertations, and books.

Coverage: International

Time Span: 1970 to date

DRI HOUSING FORECAST

Type: Source (Numeric)

Subject: Construction Industry; Economics-U.S.

Contains 13 quarterly historical and forecast time series of U.S. housing sales and prices. Covers homes for sale, sales of uncompleted, new, and existing homes, median sales price of new and existing homes, mortgage expense, and effective after-tax cost of housing.

Coverage: U.S.

Time Span: Earliest series from 1970, with 10- to 13-quarter forecasts
DRI UTILITY COST FORECASTING

Type: Source (Numeric)

Subject: Construction Industry; Energy Industry

Contains over 800 quarterly, semiannual, and annual forecast cost indexes for construction, operation, and maintenance of electric and gas utilities. Covers production and storage plants, facilities (e.g., substations), and transmission and distribution systems for the U.S. and 6 geographic regions.

Coverage: U.S.

Time Span: 12- to 15-year long-term forecasts, 25-year extended long-term forecasts, with historical series from 1972

E.H. BOECKH COMPUTERIZED BUILDING COST ESTIMATING

Type: Source (Numeric)

Subject: Construction Industry; Insurance & Insurance Industry; Real Estate

A database system for estimating replacement costs, actual cash value, or depreciated replacement cost for residential, commercial, industrial, and institutional structures. Data on labor and material costs reflect local fluctuations for every ZIP code area within the U.S.

Coverage: All U.S. ZIP code areas and major Canadian cities

ENR

Type: Source (Full Text)

Subject: Construction Industry

Contains full text of ENR, a magazine on non-residential construction. Covers materials and equipment costs, labor relations and wage rates, analyses of business and technical developments, construction law, regulatory developments, and significant contract awards.

Coverage: Primarily U.S., with some international coverage

Time Span: Mead Data Central, 1981 to date; DIALOG, 1985 to date
HANDY-WHITMAN INDEX DATA BASE

Type: Source (Numeric)

Subject: Construction Industry

Contains about 2400 annual and semiannual indexes of building costs for construction of public utilities in the U.S., aggregated for 6 geographical regions with similar economic characteristics. Also includes cost indexes for general building materials (e.g., reinforced concrete), specific types of equipment (e.g., pipe or turbo-generators), and labor rates.

Coverage: U.S.

Time Span: Primarily 1947 to date, with earliest data from 1912

HAYSTACK

Type: Reference (Bibliographic, Referral)

Subject: Engineering; Products & Vendors; Standards & Specifications

Contains over 30,000 citations to manufacturers' catalogs of electronic and mechanical engineering products, federal and military specifications (e.g., Government Construction Regulations, Military and Federal Specifications and Standards), and over 40,000 publications of standards societies (e.g., National Electrical Manufacturing Association, Underwriters Laboratories, Institution of Electrical Engineers, American Society for Testing and Materials). Provides part numbers for approximately 13 million electronic components and mechanical parts and products.

Coverage: U.S.

Time Span: Current information

HUD USER ONLINE

Type: Reference (Bibliographic)

Subject: Construction; Urban & Regional Planning

Contains over 4000 citations, with abstracts, to documents on housing and urban development. Covers building technology; housing policy and planning, including affordable housing, housing for the elderly and disabled, rent control, tenant management laws, and housing rehabilitation and neighborhood
revitalization programs; energy conservation; and economic
development and demographic trends. Sources include reports,
technical manuals, conference proceedings, monographs, and case
studies from HUD, other U.S. federal and state agencies, and
commercial publishers and professional associations.

Coverage: U.S.
Time Span: 1967 to date

IBSEDEX

Type: Reference (Bibliographic)

Subject: Construction; Energy; Engineering

Contains approximately 67,000 citations, with abstracts, to the
worldwide literature on mechanical and electrical services in
buildings, including heating, ventilation, air conditioning,
lighting and power, plumbing and sanitation, communications and
transport, and security. Also covers piping and ducting; fans
and pumps; instruments and controls; heat recovery, heat
transfer, and fluid flow; alternative energy sources (e.g.,
solar, wind); dust, filtration, and air pollution; and comfort
and environment, noise and vibration, thermal insulation,
corrosion, and humidity and condensation. Sources include
journals, reports, conference papers, books, standards, and
unpublished materials.

Coverage: International
Time Span: 1959 to date, with some materials from 1930

ICONDA (International Construction Database)

Type: Reference (Bibliographic)

Subject: Construction; Engineering; Urban & Regional Planning

Contains about 195,000 citations, with abstracts, to the
worldwide technical literature on urban and regional planning,
construction, and civil engineering. Covers architecture,
structural engineering, environmental design, engineering
geology, construction equipment and materials, interior design,
building maintenance, restoration and conservation, as well as
financial planning, municipal planning and development, and
project management. In the construction areas, covers high-rise
buildings, airports, bridges and tunnels, dams, industrial
plants, nuclear facilities, offshore structures, pipelines,
railways, and roads. Sources include periodicals, books,
research reports, business reports, theses, and conference proceedings.

Coverage: International
Time Span: 1976 to date

INFC (formerly AFIC)
Type: Reference (Bibliographic)
Subject: Construction

Contains approximately 3500 citations, with abstracts, to the worldwide literature on ferrocement, fiber composites (e.g., steel, bamboo, natural, and organic), polymer composites, and related materials. Sources include journals, conference proceedings, technical reports, theses, and monographs.

Coverage: International
Time Span: 1980 to date

LSI DATABASE
Type: Source (Numeric)
Subject: Construction Industry; Marketing-Consumer Surveys

Contains annual time series on consumption of materials and supplies for residential construction and remodeling. Covers these categories: concrete, insulation, and flooring products; heating and cooling equipment, air handling, and fireplaces; intercoms, burglar alarms, and smoke detectors; lumber, sheathing, siding, paneling, gutters, and downspouts; major appliances and water heaters; plumbing fixtures; soffit, fascia, and gypsum board materials; and windows and doors. Data are compiled from annual surveys of home builders and telephone surveys of 15,000 consumer households.

Coverage: U.S.
Time Span: 1977 to date
MARSHALL AND SWIFT COMPUTERIZED COST PROGRAMS

Type: Source (Numeric)

Subject: Construction Industry; Insurance & Insurance Industry

A database system that is part of a valuation and replacement cost service for residential and commercial structures. Contains data on building component costs for over 100 building types.

Coverage: U.S. and Canada

Time Span: 20 years to date

MSA BUILDING PERMITS (formerly SMSA BUILDING PERMITS)

Type: Source (Numeric)

Subject: Construction Industry; Economics-U.S. Regional

Contains approximately 10,400 monthly and annual time series covering numbers of building permits issued and construction values for 5 types of residential structures. Also covers construction values for 6 types of non-residential structures. Source of data is the U.S. Department of Commerce, Construction Statistics Division.

Coverage: U.S.

Time Span: 1972 to date

NAHB COUNTY DATABASE

Type: Source (Numeric)

Subject: Construction Industry; Demographics & Population; Economics-U.S.; Labor & Employment

A market research and report generation system that includes about 30 annual time series on housing starts, building permits, population, personal income, and other housing-related variables for all counties in the U.S.

Coverage: U.S.
PASCAL: BATIMENT, TRAVAUX PUBLICS

Type: Reference (Bibliographic)

Subject: Construction; Engineering; Urban & Regional Planning

Contains about 150,000 citations, with abstracts, to the worldwide literature on building and public works. Covers architectural acoustics, building maintenance, demolition, and restoration; civil engineering, related to bridges, dams, highways, nuclear plants, offshore structures, sewerages, transport facilities, tunnels, water supplies, and waterways; construction design and economics; climate, earthquake, fire, and wind considerations; geotechnics and soil; materials and equipment; project management; and regional and urban planning. Sources include books, periodicals, theses, reports, and conference proceedings.

Coverage: Primarily Europe, with some international coverage

Time Span: 1973 to date

PICA (Property Services Agency Information on Construction and Architecture)

Type: Reference (Bibliographic)

Subject: Architecture; Construction

Contains approximately 53,000 citations, with some abstracts, to the worldwide literature on construction and architecture. Covers airfields and associated buildings; building conservation; contracts, legislation, and regulations; computer-aided architectural design; energy conservation and use; failure of structures; fireproof construction; health and safety; heating, ventilation, and air conditioning; industrial construction; interior design; labor and employment in construction; marine work; plumbing and sewage systems; site organization; tunnels and tunneling; underground structures; vibration; water supply and distribution; waterproof construction; wind loads; and weatherproof construction. Sources include periodicals, monographs, reports, pamphlets, standards, government documents, and conference proceedings.

Coverage: International, with emphasis on English-speaking countries

Time Span: 1974 to date
PUBLICATIONS OF THE INSTITUTE FOR RESEARCH IN CONSTRUCTION

Type: Reference (Bibliographic)

Subject: Construction

Contains about 2000 citations, with abstracts, to theoretical and applied construction literature written or commissioned by the IRC. Covers structural engineering, materials science, construction science, building energy performance, fire research, and fire performance studies.

Coverage: Canada

Time Span: 1947 to date

REAL ESTATE ANALYSIS AND PLANNING FORECAST

Type: Source (Numeric)

Subject: Construction Industry; Real Estate

Contains 1560 quarterly and annual time series on the supply and demand for building space in 50 Standard Metropolitan Statistical Areas (SMSAs). Covers office buildings, hotels and motels, commercial warehouses, retail establishments, and single- and multi-family housing. Includes new construction starts for residential and non-residential structures, vacancy rates and number of completions and removals for non-residential structures, and office employment.

Coverage: U.S.

Time Span: Earliest series from 1967, with 5-year forecasts

RSWB (Raumordnung, Stadtebau, Wohnungsswesen, Bauwesen)

Type: Reference (Bibliographic)

Subject: Construction; Engineering; Urban & Regional Planning; Urban Studies

Contains about 300,000 citations, with abstracts, to European and North American literature on urban and regional planning and construction. Covers architecture, construction materials and building physics, computer-aided design, foundation and hydraulic engineering, construction industry, building law, town planning and urban renewal, housing, transportation planning, and environmental protection. Sources include journals, monographs, reports, conference proceedings, and standards.
SCAN-A-BID

Type: Reference (Referral)

Subject: Construction Industry; Funding Sources; Contracts & Awards

Contains requests for quotations on major construction projects worldwide financed by international organizations. For each project, includes name of project, country, type of project (e.g., dam, highway), building materials required, amount of money allocated for project, and name of person and organization to contact for further information. Also contains full text of monthly operational summaries of the World Bank and the Inter-American Development Bank and World Bank construction contract awards. Sources include the Inter-American Development Bank, the World Bank, and the European Economic Community.

Coverage: International

Time Span: November 1984 to date

VDIN (VDI-NACHRICHTEN)

Type: Source (Full Text)

Subject: Engineering

Contains full text, excluding figures, tables, and advertisements, of VDI-Nachrichten, a weekly newspaper covering engineering, economics, and the sciences. Covers such topics as production, mechanical, and precision engineering; process, plastics, and textile technology; automotive, transportation, and agricultural engineering; construction and equipment; electrical engineering, electronics, and data processing; energy and nuclear technology; design, materials technology, and automation; industrial associations and economics; and industrial practice and management.

Coverage: International

Time Span: Mid-1983 to date
Enclosed you will find the results of your computerized literature search on the topics roller compacted concrete and exterior insulation.

I am providing citations from the following databases on the Dialog System: Compendex (Engineering Index), Trade & Industry Index, NTIS (National Technical Information Service, government technical reports), and TRIS (Transportation Research Information Services). A database description precedes the citations from each database, followed by the records for roller compacted concrete, and then those for exterior insulation. TRIS, a specialized transportation database, does not contain any records on exterior insulation.

I limited the search to 1986/87 to date, to retrieve recent information only. In Compendex and TRIS there were so many citations retrieved that I limited the roller compacted concrete search to pavement applications. In Trade & Industry Index, abstracts are not provided; however, some citations have full text online available, and I am including some of these. In addition, several photocopied articles from citations found in the search are provided.

I hope that this sample search will provide you with a useful example of our service.

Sincerely yours,

Joanna Kennedy
Literature Search on
Roller Compacted Concrete
and
Exterior Insulation
October, 1989
COMPENDEX PLUS database is the machine-readable version of the Engineering Index (monthly/annual), which provides abstracted information from the world's significant engineering and technological literature. The COMPENDEX database provides worldwide coverage of approximately 4,500 journals and selected government reports and books. Subjects covered include: civil, energy, environmental, geological, and control engineering; chemical, mining, metals, and fuel engineering; mechanical, automotive, nuclear, and aerospace engineering; and computers, robotics, and industrial robots. In addition to journal literature, over 480,000 papers of significant published proceedings of engineering and technical conferences formerly indexed in Ei ENGINEERING MEETINGS are included in File 8.

Applications from around the world are indexed, including approximately 10 journals, publications of engineering societies and organizations, approximately 2,000 conferences per year, technical reports, and abstracts.

FILE DATA

COVERAGE: 1970 to the present
SIZE: 2,520,437 records
BASE CONTENT: Book Reviews
Books and Monographs
Conferences, Symposia, Meetings
Journal Articles
Reports
By September, 420,000 square yards of 10-inch-thick roller compacted concrete (RCC) pavement will have been built at Fort Drum in State New York. That's about 89 acres of RCC pavement and the largest RCC ing job ever done. The general contractor, Black River Constructors, ran the RCC placement with a test strip so the Corps of Engineers could evaluate the methods used to mix, transport, place, spread, compact, and cure the RCC pavement. The corps also evaluated the final surface appearance and flexural and compressive strengths of the RCC mix. These and other aspects of the subject are discussed.

Roller Compacted Concrete (RCC) has become an economical design construction technique for heavy duty pavements. Economics are achieved through use of fast construction, reduced jointing, and lower material costs. Though some applications may require or justify high strength and smooth faces, higher strength does not necessarily result in better economy or ice life. There are many possible examples—some may justify higher strength RCC mixes, but most will show a negative return on investment. The around point is typically reached at lower strength levels in RCC. Use of conventional mixes is less curling and curl stress. If a thicker pavement is used, use of lower strength, less shrinkage and fewer joints or cracks will r.
This article describes the successful construction of an experimental RCC (roller compacted concrete) pavement strip reinforced with types of steel fibers and presents laboratory test results obtained on site collected samples. The objective of the investigation is to serve the effect of fibers in RCC from a construction standpoint (i.e., mixing, placing, and attainable density) and discuss the improvement in strength and pseudo-ductility characteristics. (Author abstract)

The concept of roller compacted concrete (RCC), which initiated in the 1970s, has rapidly evolved over the years. Reports of use of RCC in both civil and military constructions are steadily arriving from advanced countries like USA, Canada, Australia and Sweden. Growth in the popularity of RCC can be attributed to two major advantages, which can be reaped from RCC construction. The first pertains to the rise in the speed of construction with the use of minimal and simple equipment; and the second is the economy in construction, which is reported to be in the range of 10 to 30 percent of the cost of conventional plain concrete. This study investigates the roller compacted concrete applications in pavement and dam construction.

An investigation was conducted to develop a procedure for the use of roller-compacted concrete (RCC) pavements. This paper is a report of the laboratory portion of the investigation that was conducted to
etermine the engineering properties of RCC. Specimens for the laboratory tests were obtained from a full-scale test section constructed using a ton vibratory roller. Specimens were tested for flexural, split-tensile, compressive strength; modulus of elasticity; and fatigue properties. Engineering behavior of RCC was determined to be similar to that of conventional concrete. Test results for RCC made using 243 to 285 lb/yd**3 cement show that RCC is capable of providing relatively high in-place strength. As with conventional concrete, RCC strengths produced are even higher when higher cement contents are used. Specimens prepared by using a vibrating table produced significantly lower densities and strengths because the moisture content was lowered. (Edited author abstract). 7 Refs.
Roller-compacted concrete pavement construction has made rigid low-volume pavements feasible in many situations, and the corps design method is able of addressing roller-compacted concrete pavement characteristics. Design procedures, published in Army technical manuals, have also been computerized. (Edited author abstract). 4 Refs.

7/8

86532 E.I. Monthly No: E1880487525

Title: LIMESTONE CRUSHER-RUN AND TAILINGS IN COMPACTION CONCRETE FOR PAVEMENT APPLICATIONS.

Author: Nanni, Antonio

Source: ACI Materials Journal (American Concrete Institute) v 85 n 3 Jun 1988 p 158-163

Publication Year: 1988

DEN: AMAJEF ISSN: 0889-325X

Language: English

Document Type: JA; (Journal Article) Treatment: E; (Economic/Cost/Market Survey); X; (Experimental)

Abstract: Laboratory experiments indicate that both limestone crusher-run and finely grained limestone tailings (by-products of the aggregate mining industry) can be used in concrete made with a emerging technology for flatwork construction known as roller compacted concrete). This paper reports on tests of laboratory specimens using various mixtures of mix components and proportions. The unit cost of concrete progressively decreases as the graded coarse aggregate is substituted with crusher-run and as the tailings are added. On the other hand, thepressive strength of mixtures including the crusher-run is better than that of graded coarse aggregate and is further improved by the addition of tailings. (Author abstract) 13 refs.

7/9

5755 E.I. Monthly No: E18808071681

Title: CONSOLIDATION OF CONCRETE (PAPERS PRESENTED AT A SYMPOSIUM AT THE SPRING CONVENTION).

Author: Gebler, Steven H. (Ed.)

Source: Publication SP - American Concrete Institute 96, Consol of Concr, Francisco, CA, USA, 1986. Publ by American Concrete Inst, Detroit, MI, 1987 250p

Publication Year: 1987

DEN: PSAIDE ISSN: 0193-2527

Language: English

Document Type: JA; (Journal Article) Treatment: A; (Applications); G; (General Review); X; (Experimental)

Abstract: This symposium proceedings contains 13 papers. The topics include: concrete consolidation mechanical equipment; plasticized concrete mix consolidation; compacted portland cement mixture compressive strength; roller compacted concrete density; concrete consolidation by internal and external vibrations; consolidation effect on concrete; fresh concrete consolidation experimental studies; energy requirements for concrete internal vibration; fiber forced concrete behavior under compaction; double-mixed concrete mixtures under vibrating compaction. Technical and professional papers presented at this conference are indexed and abstracted with the conference code 11244 in the Ei Engineering Meetings (TM) database produced by
abstract: This symposium proceedings contains 13 papers. The topics include: concrete consolidation; mechanical equipment; plasticized concrete mix consolidation; continuously reinforced concrete pavement consolidation; compacted portland cement based mixture; repressive strength; roller compacted concrete density; tunnel concrete consolidation; internal and external vibrations; consolidation effect on concrete fresh; consolidation experimental considerations; energy requirements for concrete internal vibration; fiber reinforced concrete under compaction; double-mixed concrete properties under vibrating action.

abstract: The first application of roller compacted concrete (RCC) occurred around 1970 for pavements with light traffic. Recent occurrences have occurred on roads carrying heavy to medium traffic loads. Instead of the SP...
This paper reviews some of the differences between roller-compacted concrete and conventionally constructed concrete pavements. These differences require additional consideration during design, and the paper presents a comparative design of a conventional and a roller compacted concrete pavement illustrating these considerations. The specific factors and their effects on design that are reviewed in this paper include trial properties, compaction, durability under freezing and thawing, construction and load transfer, strength variability, fatigue properties, and multiple lift construction. (Author abstract) 16 refs.

In October 1986 a 16,500 sq yd (14,300 sq m) roller-compacted concrete (RCC) pavement tank hardstand, the first of its kind in Europe, was built for the U.S. Army at Harvey Barracks in Kitzingen, West Germany. The paper briefly discusses the design and construction of the hardstand, the intensive quality control procedures used during the construction, and presents results of density, smoothness, and strength.
Roller compacted concrete pavements were first developed in the 1970s by the Corps of Engineers in the USA. Since that time, RCC pavements have been constructed throughout much of the U.S. The Corps' experience with RCC pavements has led to specifications for guidance in the design and construction process. General descriptions of the specifications and their objectives are provided. (Author abstract)

Roller compacted concrete is a technology which is vastly expanding beyond the traditional uses of pavement and dam oriented uses. Hornsby Bend Wastewater Treatment Plant required the use of 54,000 cubic yards (41,285 cubic meters) of RCC to be placed as a foundation for five evaporation/drying beds. Also included in this project is the first large scale application of RCC in sludge drying basins. This required multiple layer construction techniques to construct 30.5 cm (12 in.) thick RCC liners covering about 170,000 square yards (142,140 sq m) of surface. The design constraints, philosophies and procedures of this
Project are presented. (Author abstract) 1 ref.

7/16
81762 E.I. Monthly No: EIM8805-029712
Title: RENNICK YARD RCC PAVEMENT DESIGN AND CONSTRUCTION.
Author: Delva, Kevin L.
Corporate Source: Centennial Engineering Inc, Arvada, CO, USA
Conference Title: Roller Compacted Concrete II, Proceedings of the Conference.
Conference Location: San Diego, CA, USA Conference Date: 1988 Feb 2
Sponsor: ASCE, Construction Div, New York, NY, USA; ASCE, Geotechnical Engineering Div, New York, NY, USA; ASCE, Materials Engineering Div, New York, NY, USA
Conference No.: 11130
Source: Publ by ASCE, New York, NY, USA p 410-418
Publication Year: 1988
ISBN: 0-87262-632-6
Language: English
Document Type: PA; (Conference Paper)
Journal Announcement: 8805

Abstract: Rennick Yard roller compacted concrete paving project consisting of 136,000 multiplied by (times) yd^2 (113,710 m^2) was placed in June 1988. The design load for this project was a piggy-back lift with a wheel load of 110 kips (50 Mg). The Portland Cement Association's guidelines for Industrial Pavements was used to determine the inch (381 mm) required thickness. The flexural strength of the RCC material (4.8 MPa) was determined in the field by constructing a test paver. The contractor selected two ABG 410 Titan pavers to place the RCC material. The pavers operated in tandem with a 10 ton (9100 kg) following paver. Curing of the concrete was accomplished using three water sprays, maintaining the surface damp for seven days. One year after completion of the project a qualitative test was made to determine the load transfer at the joints. Joint efficiency was found to range from 92% for transverse contraction to 20% for the weakest longitudinal joints.

7/17
1761 E.I. Monthly No: EIM8805-029712
Title: RCC STORAGE PADS AT TOOELE ARMY DEPOT, UTAH.
Author: Hess, John R.
Corporate Source: US Army Corps of Engineers, Sacramento, CA, USA
Conference Title: Roller Compacted Concrete II, Proceedings of the Conference.
Conference Location: San Diego, CA, USA Conference Date: 1988 Feb 2
Sponsor: ASCE, Construction Div, New York, NY, USA; ASCE, Geotechnical Engineering Div, New York, NY, USA; ASCE, Materials Engineering Div, New York, NY, USA
Conference No.: 11130
Source: Publ by ASCE, New York, NY, USA p 394-409
Publication Year: 1988
ISBN: 0-87262-632-6
Language: English
Document Type: PA; (Conference Paper)
Journal Announcement: 8805

Abstract: RCC storage pads at Tooele Army Depot, Utah.

...
Abstract: Two 30.5 m (100 foot) by 91.4 m (300 foot) ammunition storage pads, each 381 mm (15 inches) thick, were constructed by the Sacramento district of the U.S. Army Corps of Engineers in 1986 at Tooele Army Depot, using roller compacted concrete. The pads were constructed using a single-shaft pugmill concrete plant, a double tamping paver, vibratory el-wheeled rollers and rubber-tired rollers. One pad was constructed using longitudinal lanes with long cold construction joints, and the other consisted primarily of transverse lanes with fresh construction joints. Tensile coring of splitting tensile strength and sawing of flexural strength test specimens showed excellent compaction and strength of the place RCC. Results of quality control and quality assurance testing and study of the value of frequent RCC moisture testing, a vibratory table densification test procedure, double probe nuclear density testing, the iterations in attempting to compact flexural strength specimens, and the use of an accelerated 1-day compacted splitting tensile strength test.

7/18
1760 E.I. Monthly No: EIM8805-029711
Title: PROPORTIONING RCC PAVEMENT MIXTURES.
Author: Ragan, Steven A.
Corporate Source: US Army Engineer Waterways Experiment Station, Vicksburg, MS, USA
Conference Title: Roller Compacted Concrete II, Proceedings of the Conference.
Conference Location: San Diego, CA, USA Conference Date: 1988 Feb 2
Sponsor: ASCE; Construction Div, New York, NY, USA; ASCE; Geotechnical Engineering Div, New York, NY, USA; ASCE; Materials Engineering Div, New York, NY, USA
Conference No.: 11130
Source: Publ by ASCE, New York, NY, USA p 380-393
Publication Year: 1988
ISBN: 0-87262-632-6
Language: English
Document Type: PA; (Conference Paper)
Journal Announcement: 8805
Abstract: The U.S. Army Corps of Engineers has begun using roller compacted concrete for construction of heavy-duty pavements and low volume lots and roads which are exposed to low-speed tracked and rubber-tired traffic. The pavements must withstand numerous application of oils, deicing solutions, washwater, and other chemicals which accompany the routine operation and maintenance of military equipment. The U.S. Army Engineer Waterways Experiment Station (WES) has proportioned the mixtures used or to be used in five pavements at various U.S. Army installations. Aggregates used in the mixtures included crushed stone and crushed gravel, and manufactured and natural fine aggregate. The water-cement ratio (w/c) of the mixtures ranged from 0.21 to 0.39 by weight, and all but one of the mixtures contained either Class C or F fly ash. (Edited author abstract) 6 refs.
Abstract: Over 60,000 m² of high-strength Roller Compacted Concrete (RCC) pavement has been completed in Tasmania, Australia, since December 1988. Projects have ranged from footpaths and small industrial hardstands to haul roads for mining operations and a section of public highway. Various aggregate types, gradings, and jointing systems have been used. The most common RCC mix has included a proportion of condensed silica fume (CSF), which has been found to have a significant effect on pavement strength. The mix design techniques, construction details, quality control testing, and pavement performance are discussed. Costing on various projects is presented. (Author abstract) 5 refs.

Density in roller compacted concrete is usually achieved through vibratory compaction. Factors of major influence in attaining a satisfactory end product either in the construction of roller compacted concrete dam or pavement structures. (Ed. author abstract)
Title: ROLLER COMPACTED CONCRETE II, PROCEEDINGS OF THE CONFERENCE.

Author: Hansen, Kenneth D. (Ed.)

Conference Title: Roller Compacted Concrete II, Proceedings of the Conference.

Conference Location: San Diego, CA, USA Conference Date: 1988 Feb

Sponsor: ASCE, Construction Div, New York, NY, USA; ASCE, Geotechnical Engineering Div, New York, NY, USA; ASCE, Materials Engineering Div, New York, NY, USA

I. Conference No.: 11130

Source: Publ by ASCE, New York, NY, USA 487p

Publication Year: 1988

EIN: 0-87282-832-8

Language: English

Document Type: CP; (Conference Proceedings)

Abstract: This conference proceedings contains 33 papers. The topics include: roller compacted concrete design and performance; damming, design and cost estimates; completed dam structural analysis; action characteristics; concrete construction joint shear strength; roller compacted concrete mix design; concrete mixture proportioning; storage pad construction; and pavement design.

Title: ROLLER COMPACTED CONCRETE PAVEMENTS.

Author: Malisch, W. R.

Source: Concrete Construction v 33 n 1 Jan 1988 p 13, 15, 17

Publication Year: 1988

DEN: CCCNAJ ISSN: 0010-5333

Language: English

Document Type: JA; (Journal Article) Treatment: A; (Applications)

Abstract: Roller compacted concrete for pavements is made by mixing cold aggregate with cement and water in a pugmill. More cement is used for cement-treated base (CTB) or soil cement. The cement-plus-pozzolan content ranges from 400 to 700 pounds per cubic yard and just enough water added to produce a moist earth consistency. High density is essential to develop adequate flexural strength. Tamping bars and a vibrating screed on laydown machine provide initial compaction. Rollers further compact the mix to its required density. 4 refs.

Title: PAVING WITH RCC.

Author: Keifer, Oswin Jr.

Source: Civil Engineering (New York) v 57 n 10 Oct 1987 p 65-68

Publication Year: 1987

DEN: CIEGAG ISSN: 0009-7853

Language: ENGLISH

Document Type: JA; (Journal Article) Treatment: X; (Experimental)

Abstract: Use of roller compacted concrete (RCC) for pavement is growing...
ly in the U. S. and Canada, both in civilian and military use. Roller compacted concrete pavement differs from the RCC used in dams as well as from the conventional materials it replaces. Costs are the only difference between RCC and other materials and construction procedures. It differs from soil cement in that it has coarse aggregate, cement treated base in that it has a higher cementitious material content, and from both in its use as a smooth surface course that must stand traffic and weather.

24
812 E.I. Monthly No: E18803026592
1e: COST-EFFECTIVE SURFACING FOR TRACKED-VEHICLE TRAFFIC.
1or: Shoenberger, James E.
porate Source: US Army Corps of Engineers, Vicksburg, MS, USA
lication Year: 1987
EN: XWTRBC ISSN: 0376-2262
uage: ENGLISH
ument Type: RR; (Report Review) Treatment: E; (Economic/Cost
 market Survey); Mi; (Management Aspects)
nal Announcement: 8803
tract: There is a need for cost—effective surfacings for areas exposed to tracked-vehicle traffic to reduce maintenance costs and improve safety. Surveys of several locations with tracked-vehicle traffic were made to observe pavement conditions and maintenance requirements. Observations demonstrated that pavement performance depended on how personnel perceived their problems and local repair methods. A test plan to evaluate several mixtures was constructed and tested at Fort Stewart, Georgia. The items tested were these: Fiber-reinforced concrete; mesh-reinforced concrete; Roller-compacted concrete pavement (RCCP) in thicknesses from 4 to 10 in.; Concrete paving blocks over sand-grid base; modified asphaltic concrete; Steel-slag asphaltic concrete; and Georgia standard E-Mix asphaltic concrete. The properties of the various mixes before and after construction were determined and evaluated. (Edited abstract) Refs.

25
859 E.I. Monthly No: E18802016426
1e: NOW UNFOLDING: POLYMERS, GEOSYNTHETICS, PRECAST BEAMS.
1or: Brown, Daniel C.; Munn, Walter D.
porate Source: Highway and Heavy Construction v 130 n 9 Sep 1987 p 46-51
lication Year: 1987
N: HHCODD ISSN: 0362-0504
uage: ENGLISH
ument Type: JA; (Journal Article) Treatment: A; (Applications); G; (general Review)
nal Announcement: 8802
tract: The next ten years will see new developments in construction materials such as: roller-compacted concrete; polymer concrete; asphaltic additives and geosynthetics. Predictors of pavement performance are mix stiffness, aggregate gradations and the presence of additives. Growth in the use of precast prestressed bridge girders for spans up to 120 and 160 ft is foreseen. Computers, lasers and electronics will be used in controlling field equipment performance.
Abstract: The technique of paving low-volume roads with roller-compacted concrete (RCC) has been used for 17 years in northeastern Spain. The construction costs of this technique are economically favorable when compared to other structurally equivalent alternatives. Maintenance costs are also lower and the pavement is highly durable because the strength of roller-compacted concrete is similar to that of a conventional vibrated concrete. An experimental study was undertaken in which tests were performed on core samples to check the performance of these RCC pavements in their years of service. The result is a detailed file on the performance and current condition of many of them. (Edited author abstract)
Roller Compacted Concrete Pavement is a new product. Employing own materials and techniques, Roller Compacted Concrete Pavement provides advantages and durability of concrete pavement, with the low cost of ditional asphaltic flexible pavement. The material is manufactured inially designed central pug mills or mixing plants which combine stone regate with cement and water in a continuous mix process. Fly ash is etimes used to supplement the cement and effect greater economy of erial. The paver or laydown machine is very similar to a hot mix paver. tapping bar and vibrating screed at the rear of the machine produce rly complete compaction as it is placed. Compaction is finished off to of Modified Proctor density or better by heavy vibrating flat wheelers and pneumatic tire rollers.

Roller compacted concrete (RCC) is a material that is having a acceptance, mainly in paving, because of the heavy loads it can carry due to its low cost. There have been records of the use and properavior of RCC since 1876. This paper includes examples that show theility of this material. (Author abstract) In Spanish.

Before evaluating the feasibility of one paving system over
other, several design criteria and operational characteristics had to be established. The major parameters affecting design of the intermodal light terminal were: type of container handling equipment; wheel loads; grade bearing strength; concrete pavement strength; and drainage. The primary reasons for including RCC pavement as a bid alternate for the South intermodal Yard were the Portland Cement Association's favorable reports on speed at which it could be placed and its relative insensitivity to cement during winter temperatures in the Pacific Northwest. 2 refs.

7/32
88207 E.I. Monthly No: E18704038629
title: HEAVY-DUTY PAVEMENTS.
author: Hutchinson, Ronald L.; Ragan, Steven A.; Pittman, David W.
corporate Source: US Army Engineer Waterways Experiment Station, Vicksburg, MS, USA
source: Concrete International: Design and Construction v 9 n 2 Feb 1987 p-61
publication Year: 1987
ODEN: CIDC02 ISSN: 0162-4075
language: ENGLISH
document Type: JA; (Journal Article) Treatment: G; (General Review)
journal Announcement: 8704
abstract: The Corps of Engineers' initial interest in roller compacted concrete (RCC) was for use in mass concrete construction. Recently however, Corps has also begun using RCC for construction of heavy-duty pavements for low-speed traffic. These pavements must be able to withstand fuels, deicing solutions, washwater, and other chemicals from routine maintenance of military equipment. The U. S. Army Engineer Waterways Experiment Station is currently conducting research into RCC pavement proportioning, thickness design, construction, quality assurance, and frost resistance. The results of this research will be used to develop guidance documents to assist Corps field offices in the design and construction of RCC pavements. (Author abstract) 3 refs.

7/33
88206 E.I. Monthly No: E18704038628
title: TEN YEARS OF HEAVY-DUTY PAVEMENT IN WESTERN CANADA.
author: Piggott, Robert W.
corporate Source: Canadian PCA, Vancouver, BC, Can
source: Concrete International: Design and Construction v 9 n 2 Feb 1987 p-54
publication Year: 1987
ODEN: CIDC02 ISSN: 0162-4075
language: ENGLISH
document Type: JA; (Journal Article) Treatment: G; (General Review)
journal Announcement: 8704
abstract: Roller compacted concrete (RCC) for pavements was first used in Idaho in 1976 for a log-sorting yard in British Columbia. Since then more than a dozen projects, such as haul roads, bulk coat storage, and trucking, have been built in western Canada. The paving method offers the advantages of rapid construction with readily available road building equipment, use of lower-cost marginal aggregates, and a pavement slab with properties similar to conventional concrete. Field performance has shown resistance to freeze-thaw conditions. New uses in secondary highways, streets and in aircraft facilities are being contemplated. (Author abstract)
A considerable portion of the highway pavements that have been constructed in Queensland, Australia, in the past few years have had at least one structural layer of roller compacted cemented paving. The development of pavement configurations incorporating RCCP layers has been a response from soil stabilization rather than an adoption of concrete technology. (Author abstract) 10 refs.

Roller compacted concrete (RCC) is rapidly becoming an accepted method of construction in the United States for applications other than pavements. Projects adopting this method of construction can be completed quickly and realize construction cost savings. The Railroad Intermodal Hub facility for Burlington Northern at Houston, Texas, is the first heavy-duty pavement constructed by the private sector in the U. S. An inspection of the structure after several months of operation showed the structure to be functioning satisfactorily under the heavy loading and services. (Author abstract) 4 refs.

Presents examples of two uses of roller-compacted concrete.
A pavement: an airport apron and a county road improvement. The planning, design, construction, and testing processes are described, as well as details of the mix proportions and curing methods. (Author abstract)
The pioneer project in Portland, Ore., for Multnomah County, designed by CH2M Hill and built by paving contractor Porter W. Yett Co., both of Portland. The designers estimate costs at about 20 percent less than conventional concrete and asphalt and they see little needed maintenance for 10 to 20 years. The RCC was a lean-mix, zero-slump concrete, hauled in dump trucks and paved full depth by regular asphalt paving and compaction equipment. The first roller-compacted concrete (RCC) pavement on a city street is now several months old. Visiting experts and officials believe the material will be important in highway construction in the future.
Abstract: One of the primary applications of this type of building system in residential construction, where the panels can be used for walls, s, and roofs. Houses constructed using composite panels are highly resistant to seismic forces. They are well insulated. Panels can be fabricated on-site in the desired configuration and either plastered, treated, or encased in formed concrete; they can also be used in vertical or horizontal forms to manufacture precast concrete elements. Sizes are available in a number of different wire gauges and foams, and are also available without foam. The foam core can serve as insulation for exterior walls or to lighten the dead load for interior walls and floors. Residential construction using composite panels is quickly fast and simple.

In Part A of this report, a fire in a four-story brick building in Manchester, New Hampshire, was described. This building fire exposed an entire seven-story office building located across a 20-foot alley. The office building was clad with an exterior insulation and finish system. In the present article, the authors have developed a hypothesis for the Manchester fire mechanism which served as the basis for a series of experimental trials which have duplicated the Manchester type of fire. Ultimately it was verified in small-scale prototype tests, including a mirror configuration, and in a full-scale EIFS wall section in a modern ASTM E 119 furnace. This article discusses the hypothesis and its verification, the fire tests that were performed, and the conclusions reached.
Abstract: The effects of water vapor within a building envelope which can affect its deterioration and some ways to mitigate them are discussed. The stack effect in insulated houses and the role of the air barrier is discussed. The recommended approach is to transfer the 'plane of tightness' to the exterior sheathing. By placing a rigid or semi-rigid (capillary, self-draining) insulation against the exterior sheathing, airtightness is achieved and the potential for condensation greatly reduced. By placing the insulation within the airspace, the majority of the temperature drop occurs through this element, keeping the stud space well below the dew-point temperature. This allows it to be used as a service for- and penetrations through the interior drywall do not affect the performance of the wall assembly.

Abstract: This paper presents a numerical analysis of heat transfer through a multilayer wall subjected to complicated time-dependent boundary conditions. A layer of insulating material at the exterior side or at the interior side has significant influences on the daily total heat gain or loss of the associated building. Averaged total incident solar radiation and ambient temperature functions can be used to estimate the heat transfer through the wall. (Edited author abstract) 4 Refs.

Abstract: TEMPERATURE AND VAPOR PRESSURE GRADIENTS ACROSS WALL ASSEMBLIES USING MICROCOMPUTER GRAPHICS.

Abstract: TEMPERATURE AND VAPOR PRESSURE GRADIENTS ACROSS WALL ASSEMBLIES USING MICROCOMPUTER GRAPHICS.
This paper presents the methodology used in organizing the material properties information in a database within a general purpose fitting program for diagnosing the problem of condensation within the wall assembly. Specifying the thickness and the material properties used for structure, insulation, cladding, etc., one can obtain the variation in temperature across the different layers of the wall for a set of given indoor and outdoor design temperatures. The condensation problem in the assembly can be investigated by knowing the relative humidity of the indoor and outdoor environment. Many different wall types such as cavity walls, walls with interior and exterior insulation, metal and timber clad walls can be analyzed for a number of different combinations of materials and various thicknesses. (Edited author abstract). 4 refs.

Title: Zweigeteilte Schallschutzwand auf der Glemstalbrücke der Neubautrecke Mannheim-Stuttgart.

Authors: Bienstock, Rudolf; Eisert, Hans Dieter

Corporate Source: Bahnbauzentrale, Karlsruhe, West Germany

Source: Beton — und Stahlbetonbau v 83 n 3 Mar 1988 p 70-74

Publication Year: 1988

Abstract: A 4.50 m high sound-insulation wall was erected on both sides of the Glemstal Bridge in order to reduce rail traffic noise on the new high-speed rail link. It was decided to split the structure into two sections — an exterior wall on the cornice and an interior wall on the ice beam — for aesthetic reasons and for the benefit of the bridge agency specially developed for maintenance work on the bridges of the new rail link. The paper reports on the overall design, production, installation of the exterior sound-insulation wall, as well as on structural measures for the interior sound-insulation wall. (Edited author abstract) In German. 1 ref.

Abstract: This paper presents the methodology used in organizing the material properties information in a database within a general purpose fitting program for diagnosing the problem of condensation within the wall assembly. Specifying the thickness and the material properties used for structure, insulation, cladding, etc., one can obtain the variation in temperature across the different layers of the wall for a set of given indoor and outdoor design temperatures. The condensation problem in the assembly can be investigated by knowing the relative humidity of the indoor and outdoor environment. Many different wall types such as cavity walls, walls with interior and exterior insulation, metal and timber clad walls can be analyzed for a number of different combinations of materials and various thicknesses. (Edited author abstract). 4 refs.

Abstract: This paper presents the methodology used in organizing the material properties information in a database within a general purpose fitting program for diagnosing the problem of condensation within the wall assembly. Specifying the thickness and the material properties used for structure, insulation, cladding, etc., one can obtain the variation in temperature across the different layers of the wall for a set of given indoor and outdoor design temperatures. The condensation problem in the assembly can be investigated by knowing the relative humidity of the indoor and outdoor environment. Many different wall types such as cavity walls, walls with interior and exterior insulation, metal and timber clad walls can be analyzed for a number of different combinations of materials and various thicknesses. (Edited author abstract). 4 refs.
The chimney designed and constructed for Units 3 and 4 of the Washington Generating Station Coal Conversion Project consists of a concrete wall with two acid-resistant brick liners. The liners incorporate an exterior layer of fiberglass insulation to reduce the temperature gradient through the brick wall and, hence, the tensile stresses in the brickwork. Traditionally, brick liners have been uninsulated, and although they have generally performed satisfactorily, cracking is likely to occur under many operating conditions. The reduction or elimination of cracking by means of insulation is expected to result in improved performance of the lining and reduced maintenance. This paper will discuss the stress involved, the usual development mechanism, stress testing background, and the Irvington brick liner insulation application. (Author abstract) 4 refs.

MEASURED RESULTS OF ENERGY CONSERVATION RETROFITS IN RESIDENTIAL BUILDINGS.

Author: Goldman, C. A.
Corporate Source: Lawrence Berkeley Lab, Berkeley, CA, USA
Conference Title: ASHRAE Transactions 1986. (Technical Papers Presented at the 1986 Winter Meeting.)
Conference Location: San Francisco, CA, USA
Conference Date: 1986 Jan 22
Sponsor: ASHRAE, Atlanta, GA, USA
Conference No.: 10598
Source: ASHRAE Transactions 1986 v 92 pt 1A. Publ by ASHRAE, Atlanta, GA, p 152-163
Publication Year: 1986
DOI: ASHTAG ISSN: 0001-2505
Language: English
Document Type: PA; (Conference Paper)
Journal Announcement: 8801
Abstract: This study summarizes measured data on energy savings from retrofitting existing residential buildings. Retrofits to the building shell, principally insulation of exterior surfaces, window treatments, and infiltration-reduction measures, are the most popular, though data on various heating system retrofits are now available. The average retrofit investment per unit in multifamily buildings is approximately $700, far lower than the average of $1350 spent in single-family residences. Savings achieved are typically 20\% to 30\% of retrofit space heating energy use, although large variations are observed both in energy savings and in costs per unit of energy saved. Particularly cost-effective retrofit strategies are identified based on observed energy use data. Predicted versus actual savings are also compared for groups of homes in 24 retrofit projects. (Author abstract) 14 refs.

UNSTEADY NATURAL CONVECTION IN ENCLOSURES WITH STRATIFIED MEDIUM.

Author: Shyu, R. J.; Hsieh, C. K.
Corporate Source: Univ of Florida, Gainesville, FL, USA
A numerical solution is given to study the unsteady natural convection in enclosures with stratified medium. Three designs of the enclosure wall are investigated that encompass a wall without insulation on the exterior of the wall, and insulation placed on the interior. The enclosed medium is initially stratified in the lower region and the wall temperature is uniform at the high temperature of the medium. Computation results indicate the superiority of placing the insulation inside to maintain the thermal stratification in the um. Flow and temperature fields are given for a quantitative substantiation of this observation. (Author abstract) 24 refs.

LATH AND PLASTER: A CAPSULE LOOK.

Johnston, Clay M.

Construction Specifier v 40 n 2 Feb 1987 p 54-58

Traditional lath and plaster has long been specified for shining interior walls and ceilings; fireproofing steel columns, beams, decks; and decorating columns and arches. As demands for energy efficiency and renovation increased, newer products, such as veneer plaster exterior insulating finishing systems, were developed. The article is a review of these basic lathing and plastering systems. 6 refs.

EFFECT OF INSULATING SHEATHING ON HEAT AND MOISTURE FLOW.

Timusk, J.; Doski, H. B.

Canadian Journal of Civil Engineering v 13 n 6 Dec 1988 p 674-680

Wood-frame walls with low and high water vapor permeance rating sheathings were tested in a climate simulator with respect to cure and thermal performance. Exfiltration of moist interior air through the walls was simulated by pumping moist air into wall cavities on the warm side of the climate simulator where the walls were tested. It was found that ventilation slots in extruded polystyrene sheathing did not improve the drying ability of the walls. Incomplete filling of wall cavities with glass-fiber batt insulation, the presence of ventilation, and temperature difference across the walls had, if at all, a very slight effect on thermal performance. The ability of glass-fiber-board
The author abstract: Isolating sheathing to store water condensed from exfiltrating air was achieved by installing the sheathing with the spun-bonded polyolefin facing the cold side. (Author abstract) 8 refs.
Business journals relating to trade, industry, and commerce are indexed selectively abstracted in TRADE & INDUSTRY INDEX. This database provides, in a single source, current and comprehensive coverage of trade journals and industry-related periodicals representing all standard Industrial Classifications. TRADE & INDUSTRY INDEX provides indexing and selective abstracting of over 300 trade and industry journals as well as comprehensive but selective coverage of business and economic information from nearly 1,200 additional publications. Newspapers include "The Wall Street Journal," the "New York Times Financial Section," "American Banker," and "Barrons." Journal coverage includes publications as "Advertising Age," "Coal Age," "BYTE," "Electronic Mail," "National Underwriter," "Oil and Gas Journal," and "Tax Administrator." TRADE & INDUSTRY INDEX contains the complete text of records of more than 85 of the covered journals, plus PR Newswire from 1983 to present. The file also includes the Area Business Database (ABD), which contains indexing and abstracts from over 100 local and regional business publications, from January 1985-present. In addition to general business information, TRADE & INDUSTRY INDEX provides access to information in the following broad subject areas: banking, insurance, real estate, agriculture, oil and gas, public utilities, taxation, wholesale and retail trade, construction, design and manufacturing, and paper products, and many more.

INDEXING AND ABSTRACTING FOR TRADE & INDUSTRY INDEX is also included in EARCH (File 211) for daily updating during the current month.

OCE includes: 500 trade and industry journals and newspapers, using the Area Business Databank subfile of local and regional business publications, 400 general periodicals (business articles only), legal and law-related journals and newspapers (business articles only), 5 national newspapers - New York Times, Wall Street Journal, Christian Science Monitor, Washington Post, Los Angeles Times - (business articles only), 3 newswire sources - PR Newswire (containing releases from over 10,000 corporations and organizations), Reuters Financial Report, and Kyodo's Japan Economic Newswire. Stories from these sources are usually available within 48 hours of transmission in a union file, NEWswire ASAP (File 647).

FILE DATA
COVERED: 1981 to the present
SIZE: 2,248,500 records
BASE CONTENT: Book Reviews
Directories
Journal Articles
Newspaper Articles
Software Descriptions
Press Releases
Unfolding: polymers, geosynthetics, precast beams.

In: Daniel C.; Munn, Walter D.

Way & Heavy Construction v130 p46(6) Sept, 1987

FILE: TI File 148

Illustration; photograph; table; graph

LABILITY: FULL TEXT Online LINE COUNT: 00270
CODE: 1611; 1541; 1500

IONS: SHRP: Projects and priorities.; Bulb-tee girder design (for spans up to 50 ft.).

RIPTORS: Roller compacted concrete--usage; Polymer-impregnated concrete--technological innovations; Asphalt--research; Geosynthetics--usage; Construction industry--materials; Prestressed concrete--technological innovations; Girders--design and construction

Hbreaking RCC dam sets new production marks. (roller compacted concrete)

Way & Heavy Construction v130 p51(3) Jan, 1987

FILE: TI File 148

Illustration; photograph

LABILITY: FULL TEXT Online LINE COUNT: 00102
CODE: 1629; 1771

ANY NAME(S): Tyger Construction Co.--management

RIPTORS: Concrete dams--design and construction; Upper Stillwater Dam, tah--design and construction; Concrete construction--technique

slab carries heavy loads at railroad hub facility. (Roller Compacted Concrete)

Way & Heavy Construction v129 p50(2) April, 1986

FILE: TI File 148

LABILITY: FULL TEXT Online LINE COUNT: 00075
CODE: 1611

RIPTORS: Road construction industry--equipment and supplies; Concrete usage; Roller compacted concrete--usage; Pavements--technique

concrete wins airbase test; concrete slabs recycled as aggregate in new roller-compact ed concrete base. (includes related articles)

Walter D.

Way & Heavy Construction v132 p58(3) June, 1989

FILE: TI File 148
Old concrete pavements are recycled in the roller-compacted concrete under taxiways and aprons surrounding a new hanger for Air Force One. Presidential ground facilities are being built at Andrews Air Force Base near Washington D.C. The RCC design, proposed by the contractor under contract’s value engineering (VE) clause, reduced construction costs by more than $100,000. The contractor shared cost savings with the U.S. government.

Madden Contracting & Materials Co., Inc., Upper Marlboro, Md., holds a $9.8 million subcontract to do the grading, utilities, base and paving. Hyman Construction Co., Bethesda, Md., is the prime contractor on the program to provide a new home for two new Boeing 747s that will serve Air Force One. Air Force One carries the President or other high-ranking members of the administration on trips of state. The two Boeing 707s that served that function for the last 20 years will be retired.

Included in that program is a new 140,000-sq.-ft. hangar to house the aircraft nose-to-nose, removal of nearly 30,000 sq. yd. of old concrete, runway and apron pavements, and construction of 64,000 sq. yd. of new pavements and another 20,000 sq. yd. of roads and parking areas.

Value engineering

The plans developed by the Naval Facilities Engineering Command, acting as an agent for the Air Force, called for 14-in. concrete aircraft pavements to be constructed atop a new 8-in. granular base placed over a drainage course. Rather than disposing of the old pavements in a designated on-site waste area and importing virgin aggregates for the granular base, the subcontractor proposed replacing the granular base with an 7-in.-RCC course to be constructed with aggregate made from the old concrete pavements.

"The designated disposal area for the old concrete slabs had a large deposit of good sand and gravel deposits," said Vernon Edwards, project manager for Madden. "It just didn’t seem right to bury those good natural resources with wasted aggregates from the original project, so we explored alternatives further. We found we could set up our own portable recycling plant and recycle the old concrete, as well as processing the in deposits under the waste disposal area, more economically than we’d import virgin aggregates.

Under the terms of the contract’s VE clause, the $104,000 savings (the final base would have cost about $1 million) was divided between Madden and the federal government.

Recycled concrete
Processing of the old concrete for recycling as aggregate was
atively routine. A Wolverine Whiphammer broke the 12-in.-thick plain PC
cement and a mid-sized wheel loader scooped the 12 to 18-in. rubble into
dem axle dump trucks for haul to a portable crusher set up at Madden's
crete plant. (Wolverine is now owned by Gomaco Inc.)

There, the rubble was run through a primary jaw crus h, reduced to a
maximum size, and stacked in a surge pile. A secondary roll crus h
uced that stone down to a 1-in.-minus size with less than 8 percent of
material passing a No. 200 screen.

Tiebars and other steel inserts in the recycled concrete were removed
and below the jaw crus her, and by an electromagnet before running
ough the secondary crus her.

Virgin gravel from the designated disposal site was also trucked to
 crushing plant and run through the secondary crus her only. Again the
uct was a 1-in.-minus stone with less than 10 percent passing the No.
screen.

All told, more than 14,000 cu. yd. of recycled aggregate was produced
in the old concrete rubble. Another 9500 cu. yd. of virgin specification
rial came from the waste disposal site.

"Those two sources filled our aggregate needs on this project,"
irds said. "However, we may need another 2000 cu.yd. of imported virgin
egates to finish perimeter road work."

RCC base

Madden bought a new Rexworks 12cu.-yd., Model S, single-drum, central
plant to produce concrete for the 64,000 sq. yd. of aircraft pavements
20,000 sq. yd. of vehicular parking and roadway pavements. The same
it produced the 16,000 cu. yd. of RCC mix needed for the job.

The RCC mix design was 60-percent recycled aggregate (1
in.-minus), 40 percent virgin aggregate, 7 percent cement and sufficient
r to bring the mixture to optimum moisture content.

Madden did not have a paver suitable for placing the RCC mix, though,
two competitive models were tested extensively before the company
based a new ABG Titan 411. Most of the actual RCC placement was done
a slightly-smaller, leased ABG Titan 410S.

That machine had a 10-ft. screed which could be extended to 16 ft. on
fly. Most of the base pavement was placed in 15-ft. runs with the width
changed on the fly for blockouts around fueling pits in the pavement.

The low- to no-slump mix looks like a damp, gravelly blend as it is
ed into the hopper of the laydown machine. That machine—actually an
lt paver adapted for RCC workshapes and extrudes the mix under its
 screed where it is compacted further by two oscillating tamping bars.

Specifications require that the material be compacted to 96 percent of
field Proctor, which can be achieved by the paver’s tamping bars alone
he paver runs at a speed of about 10 fpm. However, Madden’s crew
kly learned that production could be increased and paver downtime
uced by lowering the settings on the tamping bar and completing the compaction requirements with a combination vibratory/pneumatic roller.

A German-made Komatsu JV80CWA roller made six to eight passes behind the paver to complete the compactive effort. At low settings, the paver was able to advance at a rate of 15 to 20 fpm and place a smooth slab compacted 91 or 92 percent of modified Proctor.

"The vibratory drum of the roller does an excellent job of completing compaction, but it tends to tear the surface of the slab," Edwards said. "The four pneumatic tires on the rear of that roller heal those tears and produce a smooth, finished surface. The paver also produces about 50 percent more in the same time, and its downtime is reduced because of the relaxed vibratory effects on the paver."

Production data

Typical production was about 1000 cu. yd. of RCC, or about 5000 sq. per 12-hr. day.

"This simply isn't a high-production project because our maximum run only 2000 ft. and most runs are in the 500- to 1000-ft.-long range. We are very happy with the paver and the owner is pleased with the roller placed concrete base," Edwards added.

Finishing behind the roller is minimal. A wet cure-applied by running a spray truck directly over the new slab less than an hour after cement helps to easily surpass the specified compressive strengths of 750 psi in 28 days. Actual break strengths range from 1700 to 3000 psi in seven days.

An asphalt emulsion is later sprayed over the cured RCC slab to retain moisture and act as a bond breaker between the RCC base and the concrete taxiway pavement.

Edwards, General Superintendent Tom Madden and Project Engineer Dieter supervised crews of 45 to 50 working six 12-hr.-days a week on the project. Most of the grading and drainage, pavement breaking and removal, crushing of concrete for aggregate was done in 1987. The RCC base and all 14-in. PC concrete pavement was placed during the 1988 season.

Stringlines Made Easy One nifty idea noted at the Andrews AFB project Madden's system for setting up stringlines for the paver when placing on and taxiway pavements atop the RCC base.

"It was virtually impossible to drive stringline rods into the RCC base," said Tom Madden, project superintendent on the job. "We anchored them in rectangular precast concrete slabs at first, but those slabs were heavy and awkward to move later."

"Using worn out tires from our pick-ups and autos as stay-in-place means around the concrete weights solved that problem. Now our surveyors roll them to the next set-up." Geotextile Alternative Used On Another Project Another project at Andrews AFB-the construction of an rations facility for the Air National Guard—also used an alternative when softer-than-expected base conditions were discovered. The silty
Soils having a CBR of five were found under the facility's new parking and access roads which would be subject to constant traffic and heavy loads from cargo-bearing trucks.

The conventional solution of excavating the soft soils and replacing them with a select fill was estimated to cost an additional $100,000. That, when the contractor, CMS Contractors Inc., Annapolis, Md., was asked to consider an alternate design using a geotextile to underlay the paved as.

A consultant-Tri-State Explosives Inc., Bethesda, Md.-examined the soils and tested the soils. It found that the pavements required a 13-in. shed stone base without a geotextile underlay, or 8 in. with the underlay. Since the underlay would also serve as a filter, it voided the need for some underdrains originally intended only to keep subsoil fines from clogging drainage outlets.

CMS Contractors installed more than 2000 sq. yd. of Typar 340 t—a woven polypropylene filter fabric manufactured by Reemay—in cold weather accompanied by snow and freeze-thaw cycles. A 7-in. layer of crushed stone spread over the geotextile and topped with 3 in. of asphaltic concrete.

"The new road design using the filter fabric geotextile resulted in better load bearing surfaces for the parking lot and roads, and reduced our costs for excavating and compacting work," said Edward G. Cox Jr., vice president and project manager for CMS Contractors.


Thick RCC Pavements Placed Smoothly In One Pass

More than 200,000 sq. yd. of 10-in.-thick roller compacted concrete was placed last summer at Fort Drum near Watertown in upper New York State. The project—which includes the largest area of RCC paving—features several innovations in paving practice, mix design and curing procedures.

Fort Drum, a major military installation active during both World Wars, is now being reactivated after four decades of limited use by Army reserve units. New facilities now being constructed will accommodate about 800 troops and 16,000 dependents.
Black River Constructors--a joint venture of Morrison-Knudsen Co., Boise; Martin K. Eby Construction Co. Inc., Wichita; and Huber, Hunt Nichols, Inc., Indianapolis--is building a major part of the new facilities under its $517-million, 4-year fixed price contract with the Army Corp of Engineers. Black River's work started in 1987 and will be shed in early 1991.

The Project

Black River's work includes some 900 acres of clearing, 4.5 million yd. of earth excavation, 500,000 ft. trenching for various utilities, buildings and 34 miles of asphalt paving. It also includes more than 300 sq. of 10-in.-thick roller compacted concrete paving for hardds and access roads. More than 200,000 sq. yd. of the RCC pavement was ed during the second half of the 1988 construction season, with the inder to be done in 1989.

Despite the large quantities, the paving work is really a series of 1 jobs. The RCC paving--which amounts to about 87 acres of ace--occurs in seven distinct areas clustered near vehicle maintenance employment facilities.

Those seven areas each include multiple paved areas, most of which around a key building. Few of these sub areas are larger than 400 by 600 in size.

As a result of this dispersal of pavement areas and their iguration surrounding individual buildings, paying passes are short but rous.

Base preparation

"The pavement is designed to be placed in one 10 in. lift over an 8 subbase and prepared subgrade," said Bruce D. McKellar, Black River's truction manager-civil. "The specifications also require the pavement, e compacted to 98 percent of its maximum density.

"The only way that degree of compaction can be achieved is by making the base underneath the slab is hard and dense," he added. "We place base in two 4-in. lifts and compact each carefully. That surface is nd with a Gomaco GT-8500 working from stringlines to provide an rate subgrade profile. Then the pavers simply trace that grade while ing the RCC."

As added insurance, a smooth drum vibratory roller usually reseals the ed subbase to make sure it is tight and dense before the RCC is ed.

RCC placement

Two ABG Titan 4105 asphalt pavers are used to place the roller acted concrete pavement. Those Austrian-made machines have double ing bars, located behind the rear screed, that strike and compact the ice 1500 times a minute as the paver moves forward.

The RCC mix arrives in 8 cu. yd. loads in a fleet of Kenworth tandem dump trucks. The mix is dumped into the hopper of the paver as the
ir pushes the haul truck forward. Augers in front of the paver's rear ed distribute the material across the full width of the pass before the ing bars provide the initial compaction.

An Ingersoll-Rand DA-50 double drum roller follows, working in a ic mode. It usually makes six passes in the first 15 minutes before a nician tests the material with a Troxler single-probe nuclear density r. The roller makes additional passes at low vibratory settings as cted by that technician until the mix reaches 98 percent of its maximum ity.

A slightly-smaller Bomag double drum roller does the final rolling, in a static mode. Its purpose is simply to smooth any ruts or edges by the heavier initial roller.

"The tamping bars behind the paver density the material from the om up," McKellar explained. "The rollers simply complete the compaction the top down. Compaction behind the paver is usually about 90 percent, the rollers doing the rest."

Two pavers are used; one normally trails the other by less than 60 tes. Cold joints--those left exposed longer than 2 hours--must be ted with a sand-cement slurry before placing the abutting pass. Uncontrolled cracking

After the first 24 hours, the slabs are wet cured for the next 14 ites. Cold joints--those left exposed longer than 2 hours--must be ted with a sand-cement slurry before placing the abutting pass. Uncontrolled cracking

Surprisingly few slab cracks have developed. Most cracks that do or start at the corners of the cut-outs for the centrally-located rings. Some follow the seams between passes, while others radiate singly across the passes. These cracks are later reamed out and filled a hot poured bituminous sealant.

An Arans ARS-200 continuously-operating pugmill produces the mix. It s on volumetric controls; its only belt scale is on the output side of win-screw mixers.

The plant averages about 700 cu. yd. of mix per day. Each yard of mix des 3314 lb. of 3/4-in.-minus aggregates, 450 lb. of cement, 150 lb. y ash, and only 226 lb. of water.

In addition to McKellar, other key personnel on the job include ct director Richard Tucker; Tony Sandor, the construction manager for ings; and project engineer Robert Wood, P.E. Total work force is about ing the 1300 JV personnel and another 1000 from subcontractors. work five 8-hour-days a week.

PHOTO: Second paver places RCC mat at right angles to first paver's in a typically-confined paying run. More than 400,000 sq. yd. of RCC ing placed at Fort Drum as a series of small payed areas.

PHOTO: Asphalt paver places roller compacted concrete pavement for stands and access roads at Fort Drum in upstate New York. Note sharp and good surface behind paver.
PHOTO: Tamping bars on the pavers achieve 88 to 92 percent of maximum density in slabs. Densities are checked with nuclear density meter after first four passes of closely-following static roller.

PHOTO: Cracking in monolithic slabs is minor after wet cure (bottom), usually radiates out from corners. Core holes reveal good surface and density of RCC slab, while cores easily beat specified 700 psi flexural strengths after 28 days.

PROJECTS spur RCC innovation: contractor modifies RCC placement on steep slopes in Houston. (roller-compacted concrete)

A dozer-and-conveyor system proves best method to feed concrete to own machines.

About 250,000 sq. yd. of 8-in.-thick, roller compacted concrete (RCC) placed recently as "plating" on the overflow spillways for two large earthfill dams near Houston.

Whereas most RCC to date has been placed flat to build up entire dams, of it on these jobs was placed on slopes. At least 100,000 sq. yd. of went down on 1 on 3 slopes, and about 50,000 sq. yd. on 1 on 4 slopes. Rest was level crest or downstream apron paving.
Ernst Paving, Inc., Dayton, Ohio, did the RCC work at a cost of about $25 per sq. yd. under a $2.3 million subcontract to Hassel Construction Inc., Houston. Hassel holds the $5.2 million prime contract with the Corps of Engineers for safety improvements for the 11.6-mile-long Addicks and the 13.6-mile-long Barker flood control dams. Ernst's RCC work plated 1- to 2-mile-long "saddles" near the ends of each dam to protect them from erosion and washout in case of overtopping during flood conditions.

**RCC plating**

Ernst's plating work consists of four to eight passes placed along the axis of the dam (see sketch). The 15-ft.-wide dam crest and the 15-ft.-wide stream apron are both placed flat, while the 10-ft.-wide upstream wing is placed at a 1 on 4 slope. The 1 on 3 downstream slope gets one to 10- to 15-ft.-wide passes, depending on dam height, all placed along the axis of the dam.

Ernst used its self-designed, twinshaft pug mill able to produce 250 yd. of mix per hour. Up to eight haul trucks fitted with 12 cu. yd. to-Beds shuttled 8 cu. yd. loads of mix from the plant to the pavers. ABG Titan 411 Vario-Duo-Tamper asphalt laydown machines did the paving.

The plant, haul units and pavers all worked near their capacities on slabs where the haulers dump their loads directly in the pavers' hoppers. However, progress on the sloped paving was limited by the ability to deliver RCC mix from the haul trucks to the pavers.

On the initial test section, the mix for the slope paving was simply fed into the pavers' hoppers by the haul trucks, which backed up or down slopes to side-load the pavers. Although that system worked well in the section, it proved unsatisfactory in the production work due to limited access from below, or to severe rutting of the subgrade if delivered from above.

Transferring mix from the haulers to the pavers with a pair of tracked loaders was an expediency in use when the job was visited last December. However, the loaders also damaged the subgrade and controlled progress.

Later, an Ernst-designed conveyor system--actually two Caterpillar DBH rs fitted with 30 ft. conveyors--fed the mix almost continuously from haul units to the laydown machines. At that point, plating production ed up to nearly 500 ft. per day as compared to about 200 ft. per day for the initial or intermediate mix delivery systems.

"We've done a lot of flat RCC paving before, but slope paving is quite new," said D. Cory Kinnison, project superintendent for Ernst. "It took experimenting to find the best way to deliver the mix to the pavers."

**Specs control paving sequence**

Specs for the job controlled both the paving sequence and the need for compaction of the RCC behind the pavers. Paving seams exposed more than an hour were regarded as "cold joints" requiring special treatment.

Required compaction was 90 percent of modified Proctor on the slopes, was readily achieved by the twin tamping bars on the pavers, thus eliminating need for rollers on those passes. On the flat crest or apron
faces, the spec was 95 percent of modified Proctor. Two rollers—a guson pneumatic and a Bomag DW 160 AD1 double drum vibratory—were quently required on the flat slabs. Rolling, when necessary, was done in an hour of placement.

The cold joint criteria controlled the placement sequence. The initial min. paving pass was always placed on the lowest sloped downstream ting, because the sloped paving always controlled progress. The nstream apron was always placed next by the second paver working about min. behind the lead paver.

If only one downstream slope paving pass was required, that paver ed the sloping upstream face next. Set-up of the seams between the ping passes and the crest slab was delayed by wet burlap blankets placed r the upper edges of the two sloping passes.

Alternate passes

If more than one sloping downstream pass was required, the two laydown lines alternated passes until the crest was reached. The next-to-last s, in each case, was the 10- to 15-ft.-wide upstream face, with the el crest pass being placed last. When working on the sloping passes, the ers were tethered with cable from a Cat 5610 sideboom dozer which d a counterweight and rode the crest of the dam.

The irregular ends of each pass were excavated and wasted by a pillar 416 tractor/loader/backhoe at midday when another pass was to placed that afternoon. The last pass each day set overnight and was cut with a diamond saw the following morning to provide a clean, sharp struction joint for the start of that day’s paving.

Mix design for the RCC concrete was 244 lb. of cement, 223 lb. of fly 2163 lb. of coarse aggregate (3/4-in.-minus to No. 4 plus) and 1890 of sand per cu. yd. Five percent water—about 16 gal. per cu. yd.—was um moisture for the damp, gravelly mix.

Kinnison coordinated the efforts of Ernst’s team of about 30. Crews ally worked six 10-hour-days a week. The RCC work started last December was completed this spring in less than six month’s time.

PHOTO : Sideboom-anchored asphalt paver places first pass of RCC at bottom of the1 on 3

PHOTO : downstream dam face. Track loaders used to shuttle mix to 1 were later replaced with a

PHOTO : conveyor system.

PHOTO : Second paver, loaded directly by haul trucks, makes good time ing flat downstream

PHOTO : still less than an hour behind first paver.

PHOTO : Untethered paver founders when trying to place sloping eam face after crest pass

PHOTO : is placed. Work sequence was changed later to do upstream
One of the newest concepts in paving—Roller Compacted Concrete pavements—has been adopted by the American Concrete Pavement Association (ACP), which has taken an “approving” stance toward the practice. As with many new materials, ACPA’s recommendation is based on a “wait and see” approach to the practice. The ACPA report states that the technique has not been fully tested, but it has produced promising results in a number of applications.

Roller Compacted Concrete Pavements

Roller-compacted concrete is a very dry portland cement concrete, with no entrainment additives or reinforcing steel. It is an old base stabilization material and technique, used as a flat, low-speed pavement on logging roads, tank pads, container transfer points, airport aprons, container transfer points, and city streets. There are problems with durability (air entrainment and freeze-thaw) and eability, but they are being solved now.

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gely from freeze-thaw and the lack of a controlled air entrainment item.

Improved air void systems in RCC pavements can be developed, either as admixture or by restricting the amount of fines in the mix. Jointing of pavements is another problem not yet satisfactorily solved.

Part of the economics of RCC pavements stems from the reduced amount of cement, admixtures and sawing and joint sealing in current installations. Including those properties in the comparison will make conventional PC mix the likely answer wherever freeze-thaw conditions exist. But RCC pavements, we believe, will gain ground as an economic and appropriate solution, particularly in the sun belt areas.

Table: RCC COST DATE--C.O.E.

Photo: An imported asphalt paver with double tamping bars behind its feed has placed several RCC pavements. Rollers provide additional action.

Photo: The usually-dry RCC mix can be produced in continuous pug mills own) or in conventional central mix concrete plants.

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systems: quality lost in the translation? (exterior insulation and finish; includes related information)

*Use Format 9 for FULL TEXT*

technics: up against the wall; curtain walls are ubiquitous; they also are exacting and require careful design and detailing and adherence to recommendations of manufacturers.

3 offer variety of aesthetic options: their inherent benefits include a range of colors and textures and the ability to create special shapes. (exterior insulation and finish systems)
Adding value and distinction to rehabilitated structures

Few cladding systems can match the benefits of retrofitting a building exterior insulation and finish systems (EIFS). Highly versatile and weighing less than 2 lbs./sq. ft., EIFS solve air and water iteration problems in deteriorating buildings by creating a new building envelope.

In addition, because the systems are applied to the exterior, usable floor space is not consumed and employees can work without disruption. The four renovation projects described here are examples of designers and building owners can capitalize on the use of EIFS.

Joining dissimilar structures
An increasing number of cladding specifiers are becoming aware that "S" offer the opportunity to inexpensively join two or more buildings with similar appearances. A case in point is the Mallory Joint Implante geon Center, located in Columbus, Ohio.

The renovation, which was completed in May, consisted of unifying two adjacent buildings: one with a reinforced concrete structure, the other a metal/bar joist structure. According to Seth Pymer, president of er Plastering Inc., Columbus, Ohio, the project's general contractor, use of an expanded polystyrene (EPS) insulating system and a synthetic cco finish allowed the firm to create a juncture that is imperceptible.

The system, a hard-coat, polymer-modified (PM) type A system manufactured by Conproco Corp., Concord, N.H., was mechanically attached to masonry walls. The 2-in. thick polystyrene insulation boards used, ch have an R factor of 4.17 BTU/hr. at 40 degrees F, provide energy savings.

The reinforced-concrete facility, which had been built in the early Os, had nominal insulating value. Nor was it constructed with straight Is. Pymer suspects that the forms were removed too quickly. The bows and irregularities were leveled out by adding a good deal more of the glass reinforced cementitious base coat to the outside of the foam n usually required.

Explained Pymer, "Normally, the base coat need be only 1/8 in. thick as a performance standpoint. In this instance, in some areas the thickness was as great as 3/4 inch. Consequently, the material and labor ts were somewhat higher." According to Pymer, the installation costs about $6.50/sq. ft. in flat surface areas and approximately $7.50/sq. ft. for the building's cornices. Typically, Pymer added, installed costs of flat surfaces are about $4.50/sq. ft., depending on the amount of liling. Approximately 13,000 square feet of insulation was used.

"Had we known that we were to straighten out the walls, we would have ed out the walls and put gypsum sheathing on it. There's still a slight vesness in the wall, but it's hardly noticeable because of the bays, nces and moldings we added to the project," Pymer said.

All the relief on the outside of the building is built-up foam, save the window bays and two fascia systems. The design elements were made EPS that varied in thickness from 1 inch to 6 inches, according to e Pheneger, a partner with Neuenschwander & Pheneger, Columbus, Ohio, project architect. Many of the thicknesses were achieved merely ng layers of insulation, he said.

The new design treatment included several window bays in the forced-concrete portion of the center. "For the bays, we built out the ting walls with metal studs and gypboard and added an inch or two of on top of that," Pheneger said. "We determined that it would be more le and cost effective to construct them in this manner rather than to y 6 or more inches of foam on a flat wall surface."

"When the thickness of the material exceeds 6 inches, it becomesicult to attach it to any existing substrate. Not only is a drive pin ired to secure it, but the material cost of the foam begins to increase
Furthermore, Pheneger said, he would not recommend trying to excessively attach an EIFS system to a substrate when system thickness needs 3 inches. Otherwise, the dead weight of the material may cause the system to become unglued.

"In addition, attaching a system with an adhesive often necessitates removal of any loose paint or release agents with acids or primers. In mechanical systems, as long as the appropriate fasteners are used, it is not necessary to prepare the substrate," Pheneger said.

Distinction is key to Pepsi-Cola retrofit

The high durability of a polymer-modified (PM) exterior wall assembly, joined with the flexibility of a polymer-based (PB) thin-coat system, allows designers to customize building details, including trademarks, emblems and corporate logos.

A recent example is the retrofit of Pepsi-Cola's regional bottling headquarters in Rochester, Minn. Like the Mallory Implant Center, the retrofit involved the joining of two free-standing buildings: a bottling facility constructed in the 1950s and a former bus garage. An addition now connects the buildings, serving as the main entrance and containing a conference room. The reconstructed facility contains 52,000 square feet of space.

According to Jim Springborg, project architect, Architectural Design Group, East Rochester, Minn., the owners wanted a rehabilitated structure with a distinctive, innovative design. The solution called for the use of a hard-coat and thin-coat exterior insulation system from Senergy Inc., Cranston, R.I.

The hard-coat system, a 2-in.-thick EPS board, was used to create a mechanically fastened, energy-efficient envelope for the building. The more flexible foam shapes of the system permitted the crafting of a 20-ft. cured replica of the Pepsi logo and incorporating it, along with other details, into the EIFS design.

Extending from the logo are three red and three blue stripes. Each stripe is a 6-in.-wide, 1-in.-deep hand-built reveal. The bottom edge of the logo itself, at a 30 degree angle, is beveled, as well as the logo itself, for proper water run-off.

The thin finish coat was spray-applied to achieve the smooth finish red by the owners. Obtaining a uniform look on the logo required that it be sprayed four times — red and blue first, then silver. According to the owners, spraying uses about 50 percent more material, but requires less time.

"Custom details like the reveals and the logo can be prefabricated by manufacturers, but we prefer doing it ourselves onsite, where we can adapt the system to the irregularities of the building," he commented.

Separately, another benefit of using EIFS in retrofit applications is the ability to adapt to an existing roof. For example, in the Pepsi retrofit, the hard-coat system was tapered to fit beneath existing metal hinging. The existing seam was reinforced with new flashing on top of the
According to Eide, the technique saved money because the old flashing did not need to be removed and because the chances for leaks were minimized.

Instant decision-making

The possibility for instant decision-making on site was also cited by designers of 103 West Restaurant, Atlanta, as a major benefit of an EIFS system.

"The material is very forgiving," said Penny Goldwasser, president of Goldwasser Inc., Atlanta. "It allows you to lower or raise arches, change the angle of a cornice, the length of sill, what have you -- all at a moment's notice. If a feature does not evolve as was hoped, it can be worked at a moment's notice." Goldwasser, an interior designer, joined forces with Billy Joe Donaldson, president of Multi Plastering Co., Decatur, Ga., to create the exterior design elements. The project architect was Allegretti & Associates, Stone Mountain, Ga. Tatum Construction Co., Atlanta, was the general contractor.

The $50,000, three-month renovation was completed last October. Included were a new exterior surface, numerous decorative crowns and arches, pilasters capped with ionic capitals. "Much of the treatment was cut from foam blocks into two-dimensional shapes, to which a hand-rolled third dimension was added," Donaldson said.

The EIFS system used, manufactured by Dryvit System Inc., Mt. Penn, Pa., was finished with a 100 percent acrylic finish coat for durability and weather resistance. To avoid the need to prepare the stucco surface of existing concrete substrate, Donaldson opted to attach the system mechanically. A metal lath was nailed onto the wall, and the EIFS system adhesively attached to the lath. Laths, usually made of 0.5 gauge galvanized steel, typically add $0.50/sq. ft. to the cost of a project, Donaldson said.

He added that despite the fact that custom details such as these put off the construction schedule and increase the cost of a construction project, a growing number of designers are using the material to meet the owners' aesthetic requirements.

PHOTO: The window bays of the Mallory Joint Implant Surgeon Center, Columbus, Ohio, were constructed with metal studs and covered with an EIFS system from Conproco Corp., Concord, N.H. (top). Portable heaters and sheet covers allowed work to progress in the dead of winter (above).

PHOTO: Chosen primarily for its design flexibility, Ispec Inc.'s exterior insulation and finish system also provides My Mechanic Inc.'s renovated headquarters with insulation against New England winters (top). The new art deco exterior of the office building, which is located in Waltham, Mass., is an improvement over its predecessor, a silver processing plant (above). Keyes Associates Waltham, Mass., was the project architect. The general contractor was Rumford Builders, Rumford, R.I.; the stucco er was Synthetic Stucco Systems, Raynham, Mass.

PHOTO: Renovations to 103 West Restaurant, which included a new exterior surface in shades of gray-green and pink, were completed last
PHOTO: Retrofit of the Pepsi-Cola regional headquarters in Rochester, N.Y., included joining two adjacent buildings. Project architect Jim Ngborg of Architectural Design Group, East Rochester, Minn., connected structures with an addition of a false parapet and two exterior cladding systems manufactured by Sensergy Inc., of Cranston, R.I.
NTIS database consists of government-sponsored research, development, and engineering plus analyses prepared by federal agencies, ir contractors, or grantees. It is the means through whichlassified, publicly available, unlimited distribution reports are available for sale from agencies such as NASA, DDC, DOE, HUD, DOT, artment of Commerce, and some 240 other agencies. In addition, some te and local government agencies now contribute their reports to the ase.

ly multi-disciplinary, this database covers a wide spectrum of jects including: administration and management, agriculture and d, behavior and society, building, business and economics, chemistry, ll engineering, energy, health planning, library and information ence, materials science, medicine and biology, military science, nsportation, and much more.

RCE

NTIS database represents the reports of three major U.S. federal ernment agencies: U.S. Department of Energy (DOE), U.S. Department ence (DoD), National Aeronautics and Space Administration (NASA), s many other agencies.

LOG FILE DATA
ES COVERED: 1964 to the present
E SIZE: 1,341,570 records
ABASE CONTENT: Bibliographies
Conferences, Symposia, Meetings
Government Documents
Journal Articles
Microforms
Patents
Reports
Standards
Theses and Dissertations
Translations
Roller-Compacted Concrete

NTIS Tech Note)

Department of the Army, Washington, DC.

7/2

NTN88-0877

IS Prices: Not available NTIS

This citation summarizes a one-page announcement of technology available utilization. Roller-compacted concrete pavement (RCCP), a construction technique for placing rigid pavement using asphalt paving equipment and tools, was first used in the Pacific Northwest. It was pioneered for dam construction by the Corps of Engineers, and was used at Ft. Hood, Texas, in 1985. However, the performance of the construction material under field freeze-thaw conditions is still unknown. CRREL constructed six instrumented RCCP test sections and two standard PCC control sections. CRREL also installed temperature instrumentation in an 18-in.-thick RCCP at a containerized shipping terminal and is monitoring its freeze-thaw performance. Tests conducted on 200 freeze-thaw cycles showed no change or degradation.

/3

PB88-239736/XAB

Transportation Design

Wers; R. L.; Zaniewski, J. P.; Tia, M.; Armaghani, J. M.; Wu, C. L.

Transportation Research Board, Washington, DC.
12 papers in the report deal with the following areas: nine-year performance evaluation of Arizona's prestressed concrete pavement; FEACONS computer program for analysis of jointed concrete pavements; thickness of roller-compacted concrete pavements; engineering properties of er-compacted concrete; field analysis of rutting in overlays of rete interstate pavements in Illinois; dynamic response of paving rials; analysis of axle loads and axle types for the evaluation of load ts on flexible pavements; reliability of the flexible pavement design l; analytical evaluation of variables affecting surface wave testing of ments; nondestructively delineating changes in modulus profiles of ndary roads; combined effect of traffic loads and thermal gradients on rete pavement design; effect of concrete overlay debonding on pavement ormance.

The two-volume publication contains 65 papers, including six abstracts, ented at ten sessions during the October 1987 event. Some topics ed basic research themes, such as: new studies of fly ash, fly ash rete, and important properties and construction uses; updated ash ling and testing procedures; advances in fluidized bed combustion ), flue gas desulfurization (FGD), and other sulfur dioxide control ucts; and latest pozzolan programs of the Cement and Concrete Reference ratory (CCRL) of the National Bureau of Standards. Other topics focused applied coal ash technology, including: airports; highway and dam truction; structural fills; flowable fills; roller-compacted rete; lightweight building products; recovery of metals from coal ash; ers for paints and plastics; and new coal ash uses in agriculture and motion. (ERA citation 12:049257)
surveys of several locations with tracked-vehicle traffic were made to serve pavement conditions and maintenance requirements. These observations demonstrated that pavement performance depended on how local personnel perceived their problems and local repair methods. A test section evaluate several mixtures was constructed and tested at Fort Stewart, Georgia. The items tested were: (a) Fiber-reinforced concrete; (b) e-mesh-reinforced concrete; (c) Roller-compact concrete pavement (CP) in depths from 4 to 10 in; (d) Concrete paving blocks over sand-grid; (e) Latex-modified asphaltic concrete; (f) Steel-slag asphaltic concrete; (g) State of Georgia standard E-Mix asphaltic concrete. The properties of the various items before and after construction were examined and evaluated. Trafficking on the test section consisted of military traffic with M60A-1 tank and M-88 tank retriever traffic in addition minor car and light truck traffic. Locked track turns were performed on each item, and the pavement surface was evaluated. Results of this study indicated that all items tested provided a satisfactory surface when properly prepared. RCCP provides a suitable surface for roads and parking as at favorable costs compared to conventional concrete. Paving blocks provide a suitable surface and the ability to remove and replace or relevel individual blocks can offset their high-cost, labor-intensive installation. asphalt pavements evaluated, while not as resistant to abrasion as concrete pavements, are less expensive to construct and repair.
Guide for Design and Construction of Roller-Compacted Concrete Pavements

Roller-compacted concrete pavement (RCCP) provides a lower-quality, economical alternative to slipform and fixed-form concrete pavements. It is especially suited for areas where heavy, low-speed vehicles such as tanks or container handlers are the primary users of the pavement. RCCP is constructed by placing a zero-slump portland cement concrete mixture with asphalt paver and compacting it with several passes of a vibratory roller. By using this construction method, wherein large quantities of concrete can be placed quickly with a minimal amount of labor and equipment, savings of 30 percent over conventional concrete paving methods have been reached. The final RCCP surface is not as smooth as a conventionally constructed concrete pavement, and the surface texture resembles that of an asphaltic concrete pavement surface. Quality control assurance consists of testing materials going into the concrete, checking the plant calibration regularly, measuring the in situ density of the finished product, and the thickness. Inspectors at the plant and on the jobsite are all to ensure that a quality RCCP is being built.
his thesis studied the possibility of Roller Compacted Concrete Pavement (CP) use by the United States Air Force. RCCP is a dry, zero-slump concrete paving mixture. The low cost, high strength, and quick placement make it extremely attractive as an alternate construction and air method for USAF pavements. This project accomplished five objectives. First, a thorough review of the literature provided a list of advantages and disadvantages of RCCP. Second, a survey determined the knowledge level of a small group of USAF Pavement Engineers. Third, the survey established the relative importance of certain pavement characteristics in various USAF pavement applications. Fourth, a decision model was created to assist in the selection of candidate U.S. Air Force RCCP projects. Finally, using this model, the Strategic Air Command database was searched to provide a list of recommended RCCP projects.

Egan, Steven A., Engineer Waterways Experiment Station, Vicksburg, MS. Structures

Investigation was conducted to evaluate the frost resistance of samples taken from roller-compacted concrete (RCC) pavements using laboratory testing procedures. Nine existing pavements were sampled and evaluated for microscopical determination of air-void content and parameters of the air-void system, resistance to rapid freezing and thawing, critical parameters, and compressive and flexural strength. The pavements ranged in age from 1 month to 8 years at the time of sampling. Preliminary results of dilation tests indicate that those samples judged to be frost susceptible when tested by rapid freezing and thawing, may, in fact, offer a degree of frost resistance. The dilation test may be appropriate, therefore, to determine whether a RC sample is frost resistant at the time of testing or to measure the period of frost immunity.
Impact of CFC (Chlorofluorocarbon) Restrictions on US Building Foundation Performance

Christian, J.

Ridge National Lab., TN.

Port No.: ORNL/CON-245

Contract No.: ACO5-840R21400

Significant increase in the use of foundation insulation had been noticed as a result of the near completion of ASHRAE 90.2P, New Building Efficiency Standard, and the publication of several Department of Energy foundation design tools. Potential restrictions on the future availability and/or price of chlorofluorocarbon (CFC)-12 will have a potentially substantial impact on the goal of improving the efficiency of building foundations. One of the better ways to insulate foundations is on exterior in contact with the earth, and one of the better insulating products for this application is extruded polystyrene (XEPS). According to personnel in the Environmental Protection Agency, it is likely that use XEPS is currently blown with CFC-12 and since CFCs could be a major contributor to anticipated future ozone depletion, some restrictions are being considered. The work statement for this analysis called for an initial impact analysis on energy conservation goals and a foundation research plan to mitigate the impacts of restricting the use of CFCs in foundation insulation systems. This report addresses quantitatively the energy-saving impacts at the state level of CFC restrictions on foundation insulation and indicates that the total impact could be anywhere from near zero to 0.8 percent in the year 2010, with the most likely impact being about 0.13 percent/year. The risk of high impacts can be reduced by an accelerated research effort focused on developing and demonstrating insulated foundation systems that have overall performance equivalent or superior to that of exterior XEPS insulated basement walls, crawl space walls and on-grade systems. 27 refs., 14 figs., 19 tabs. (ERA citation 21899)

PB88-122148

Effect of Wall Mass on the Annual Space Heating and Cooling Loads of Buildings

Licitra, B. A.

National Bureau of Standards (NEL), Gaithersburg, MD. Building Equipment

The space heating and cooling loads for a house containing partition walls and interior furnishings is simulated using a computer program called P. Separate computer runs are carried out for the following wall structures: insulated wood frame; insulated masonry with mass on the exterior; and insulated masonry with insulations sandwiched between interior and exterior mass. The reductions in annual space heating and cooling loads achieved in the houses with masonry wall construction are compared to identical houses with lightweight wood-frame wall construction, computed for five climates.
S provides transportation research information on air, highway, rail, maritime transport; mass transit; and other transportation modes. Projects included are regulations and legislation, energy, environmental maintenance technology, and operations, traffic control, and communications. The database records can be either abstracts of documents and data holdings or resumes of research projects. The major S subfiles are as follows: the Highway Research Information Service (HSIS), the Maritime Research Information Service (MRIS), the Railroad Information Service (RRIS), the Air Transportation Research Information Service (ATRIS), and the Urban Mass Transportation Research Information Service (UMTRIS), Highway Safety Literature (HSL), International Road Research Documentation (IRRD), and Transportation Libraries (TLIB): joint contributions by the Northwestern University Library and the University of California, Berkeley, Institute of Transportation Studies Library.

S provides international coverage of ongoing research projects, listed journal articles, state and federal government reports, conference proceedings, research and technical papers, and monographs.

LOG FILE DATA
ES COVERED: 1968 to the present
SIZE: 272,679 records
BASE CONTENT: Journal Articles
Reports
file-compacted concrete (RCC) was used for the base under taxiways and
ns surrounding a new hanger at Andrews Air Force Base in Prince Georges
ty, Maryland. The Base houses Air Force One, which carries the
ident or other high-ranking members of the administration on trips of
. The RCC design reduced construction costs by more than $100,000. It
suggested by the subcontractor and proposed by the contractor under the
ct's value engineering clause. The subcontractor was Madden
acting & Material Company, Incorporated, Upper Marlboro, Maryland;
had a $9.8 million subcontract to do the grading, utilities, base and
ge, George Hyman Construction Company, Bethesda, Maryland was the prime
actor. The savings were divided between Madden and the federal
ment. Details of the construction are provided in this article.

Modal yards now have greater space utilization due to the use of new
ing equipment that allows boxes to be stacked with no room between
This requires a 28-inch thick pavement to hold the boxes without
ing the concrete. Roller Compacted Concrete (RCC) provides such
ments. RCC pavement can be divided into two categories: those pavements
for dirty operations and those pavements used for clean operations. A
operation is one in which the handled product leaves the pavement
ed with a residue. A clean operation, typical of an intermodal yard,
es material that is containerized. This type of operation requires
ing equipment that moves at a relatively fast speed. Looks and
ance are important here, and the surface tolerance is more critical
that of a dirty operation. The U.S. Army Corps of Engineers is
menting with straight-on curing compounds for RCC pavements, and this
ing considered as a standard procedure for RCC. This paper appears in
port Research Circular No. 350, Ports, Waterways, Intermodal
als, and International Trade Transportation Issues, Proceedings of
RED CONCRETE IN INTERMODAL YARDS AT THE PORT OF TACOMA
atcliffe, CL
transportation Research Board
transportation Research Circular N350 May 1989 pp 32-34
JBFLIE: MRIS; RRIS
AVAILABLE FROM: Transportation Research Board Publications Office 2101
stitution Avenue, NW Washington D.C. 20418
The Port of Tacoma has a North and a South intermodal rail yard. The
yard was constructed in 1985 and was made exclusively of Roller
acted Concrete (RCC). It covers about 13 acres, was constructed in 120
andar days, and cost $2 million. The North intermodal yard covers 23
es and cost $4 million. It has both RCC and cast-in-place surfaces that
performed well. The two yards are operated differently. The South yard
Top picks and the North yard uses straddle carriers. This paper
ares the two yards with regard to their method of construction,
fomance, and maintenance. This paper appears in Transportation Research
cular No. 350, Ports, Waterways, Intermodal Terminals, and Internat
erland Transportation Issues, Proceedings of the 13th Annual Summer

SPHALT CONCRETE PAVED YARD FOR THE UNION PACIFIC IN SEATTLE
ones, LB
transportation Research Board
transportation Research Circular N350 May 1989 pp 30-32
JBFLIE: RRIS
AVAILABLE FROM: Transportation Research Board Publications Office 2101
stitution Avenue, NW Washington D.C. 20418
Union Pacific Railroad Company's Seattle Intermodal Facility was
ended approximately 3,300 feet by 500 feet. The location has a
plain about 2 to 12 feet below the present ground surface. Site
igations revealed extremely variable subsurface materials. The entire
proved-rolled with a fully loaded 50-ton pneumatic-tired roller
50 psi tire pressure. By 12 passes the soft areas were detected and
Boundaries delineated for future excavation. Designs were developed
ortland cement concrete and asphaltic concrete pavements. No design
pared for Roller Compacted Concrete pavements because of the soft
deformable subgrade likely to be present during construction. The Union
Road Railroad Company secured bids and much of the work was done during
all weather and paving was done in January 1987. The new facility has
en in service about 1-1/2 years. It has been subjected to high
-Packer and trailer usage. The only known pavement failure has been a
section at the trailer entrance where there was insufficient removal
soft material. This paper appears in Transportation Research Circular
350, Ports, Waterways, Intermodal Terminals, and International Trade
portation Issues, Proceedings of the 13th Annual Summer Conference,

INSTRUCTION OF A ROLLER COMPACTED CONCRETE PAVEMENT HARDSTAND AT
INGEN, WEST GERMANY --14TH ARRB CONFERENCE, 28 AUGUST - 2 SEPTEMBER,
, CANBERRA, ACT, AUSTRALIA; PROC. PARTS 1 - 8
ottman, DW
October 1986 a roller compacted concrete pavement (rccp) hardstand, first of its kind in Europe, was built for the United States army at a barracks in Kitzingen, West Germany. This paper discusses the design considerations and construction techniques of the "Zhivique paving method," as well as the intensive quality control procedures used. The results of the quality control tests, particularly the in situ density determinations with nuclear gauge; the strength and unit weight of cores, cylinders, and slabs; and the smoothness tests are presented and compared to specification requirements. Correlations of roller passes to in situ density, splitting tensile and flexural strength to sample density, flexural strength to tensile strength, and nuclear gauge density and moisture content are given. Implications to modified Proctor test results, are also presented. Lessons learned from observation of the construction procedure and tests that might improve the overall quality of rccp are also presented.

For the covering record of the conference, see IRRD no 808936.

14 DA

SIGN AND CONSTRUCTION OF ROLLER COMPACTED CONCRETE PAVEMENTS -- 14TH CONFERENCE, 28 AUGUST - 2 SEPTEMBER, 1988, CANBERRA, ACT, AUSTRALIA; PARTS 1 - 8

Roller compacted concrete pavements are constructed of zero slump and cement concrete placed with construction procedures similar to those used with asphalt concrete. These construction procedures can result in cost savings of 10 to 30 per cent compared to conventional concrete construction. When properly proportioned and constructed, roller compacted concrete has strength equal to or greater than conventionally constructed concrete pavement with the same cement content. Roller compacted concrete pavement is not as smooth and has an open surface similar to asphalt concrete. Its major application has been for trial pavements where these surface characteristics are acceptable; as construction procedures improve, roller compacted concrete use is expanding to higher quality pavements. This paper reviews the procedures to proportion, construct, and design roller compacted concrete and discusses some areas needing further improvement and research. For the covering record of the conference, see IRRD no 808936.

83 DA

PAVEMENT REINFORCED WITH STEEL FIBERS

American Concrete Institute


FILE: HRIS

AVAILABLE FROM: American Concrete Institute 22400 Seven Mile Road Detroit, Michigan 48219
A study is reported which observed the effect of fibers in RCC (roller compacted concrete) from a construction standpoint (i.e. mixing, placing, and attainable density). An experimental roller compacted concrete pavement trial reinforced with two types of steel fibers has been successfully constructed. Laboratory test results obtained from site-collected samples are presented. The improvement in strength and pseudo-ductility characteristics are discussed. The study indicates that the addition of steel fibers in RCC does not affect preparation or placement of the mix. Test results showed that the mechanical properties improve with the addition of fibers. Composite properties are improved in terms of strength and pseudo-ductility.

Roller compacted concrete (RCC) is a zero slump portland cement concrete mixture that has been used since the early 1970's in massive concrete structures. Iowa Highway Research Board project HR-300 was established to determine if this type mix could be used to pave roads on the Iowa road stem. Manatt's Inc. of Brooklyn, Iowa agreed to pave an 800 ft. x 22 ft. 10 in. section of RCC pavement in their Ames construction yard. This port discusses the construction of the test slab and interprets test results conducted during and after construction. It was observed that RCC can be placed with conventional asphalt paving equipment. However, there are several problems with RCC paving which must be resolved before RCC can come a viable paving alternative on Iowa's roadway system.

More than 200,000 sq. yd. of 10-in. thick roller compacted concrete (RCC) pavement was placed in the summer of 1988 at Fort Drum near Watertown in New York State. The project—which includes the largest area of RCC paving yet—features several innovations in paving practice, mix design and paving procedures. Black River Constructors is building a major part of the facilities at Fort Drum under its $517-million, 4-year fixed price contract with the U.S. Army Corps of Engineers. Work started in 1987 and is expected to be finished in early 1991. This article describes the project, base course preparation, RCC placement, and crack sealing.
PAVEMENTS OF ROLLER-COMPACTED CONCRETE - PHYSICAL PROPERTIES

Andersson, R
NORSKE BETONGFORENING
NORDIC CONCRETE RESEARCH NS Dec 1987 7-17

A project concerning pavements of roller-compacted concrete is in progress at the Swedish cement and concrete research institute (cbi). This project deals primarily with testing methods and physical properties in respect of roller-compacted concrete. This report contains an account of results of tests carried out to determine physical properties in relation with placing 54 small test pavements, approx 3 sq m each, which were cast in the field under controlled conditions. The composition and paction of the concrete were varied in order to throw light on the extent these factors have on the physical properties. The compressive strength and splitting strength of the pavements was tested on core samples er 28 and 200 days respectively. The results are related to the degree of compaction and composition of the concrete in the pavements. Frost resistance and shrinkage were studied on extracted samples and are related to the concrete standards applicable in Sweden as well as conventional cement concrete used as a reference.(a) for the covering abstract see 0 812077.

7/12
312 DA
N AIRPORT APRON AND A COUNTY ROAD

Brans, JM; Jacksha, JL
American Concrete Institute
Concrete International: Design & Construction VOL. 9 NO. 2 Feb 1987 pp 36 3 Ref.

 AVAILABLE FROM: American Concrete Institute 22400 Seven Mile Road Detroit Michigan 48219

This article presents examples of two uses of roller-compacted concrete: an airport apron and a county road improvement. The planning, design, construction, and testing processes are described, as well as details of the mix proportions and curing methods. (Author/TRRL)

7/13
311 DA
URLINGTON NORTHERN RAILROAD INTERMODAL HUB FACILITY

Logie, CV; Oliverson, JE
American Concrete Institute
Concrete International: Design & Construction VOL. 9 NO. 2 Feb 1987 pp 41 4 Ref.

 AVAILABLE FROM: American Concrete Institute 22400 Seven Mile Road Detroit Michigan 48219

Roller compacted concrete (rcc) is rapidly becoming an accepted method of construction in the United States for applications other than dams. Projects adopting this method of construction can be completed quickly and at a lower construction cost savings. The railroad intermodal hub facility for Burlington Northern at Houston, Texas, is the first heavy-duty rcc pavement constructed by the private sector in the U.S. An inspection of the structure after several months of operation showed the structure to be operating satisfactorily under the heavy loading and service conditions. (Author/TRRL)
In recent years, roller compacted concrete has been used in the construction of dams and pavements. The construction methods of soil cement lean concrete roads bases have been applied to cement and aggregatetures, proportioned to achieve similar properties to conventional crete pavements. This paper reviews these developments from the point of w of pavement design and construction and shows this technique to be licable to New Zealand conditions. For the covering abstract of the posium see IRRD 810782. (Author/TRRL)

This report presents the development of test methods and an inspection edule for roller-compacted concrete pavements. Since suitable methods are not available for determining compactibility, a new method was sloped for this purpose. This method is called the ra method. Theipment required for the ra method consists of a test cylinder clamped toibrating table. 2.5 kg concrete for roller compaction is inserted in the ylinder. A cylindrically shaped extra weight is raised and placed on of the concrete. The ra method determines the settlement of the crete in millimeters after vibrating for 20 seconds. The method proved rapid, simple and practical, at the same time as it constitutes an cient aid to concrete production. The cannon, vebe and vebe(m) test methods did not meet the requirements for determining maximum dry density, um moisture content and for making specimens for testing hardened crete. Other methods which could not be used for various reasons were production of specimens on a conventional vibrating table or a laboratory tamping method -modified Proctor -so commonly used in soil action. Instead, vibratory compaction from above proved to be the best had. Two types of vibrator were tested and were developed in several se types. The test method thus developed for vibratory compaction of concrete simultaneously determining the dry density and manufacturing 150 mm specimens is called the kango(cube) method. The kango(cube) method isribed in English in detail. The test methods produced as described re used for inspecting roller-compacted concrete in accordance with
In an investigation was conducted to develop a procedure for the design of roller-compacted concrete (RCC) pavements. This paper is a report on the laboratory portion of the investigation that was conducted to determine the engineering properties of RCC. Specimens for the laboratory tests were obtained from a full-scale test section constructed using a 10-ton vibratory roller. Specimens were tested for flexural, split-tensile, and compressive strength; modulus of elasticity; and fatigue properties. The engineering behavior of RCC was determined to be similar to that of conventional concrete. Test results for RCC made using 243 to 285 lb/cu yd cement show that RCC is capable of providing relatively high in-place strength. As with conventional concrete, RCC strengths produced are even higher when higher cement contents are used. In another phase of the investigation, mix proportioning procedures for RCC were investigated. Specimens were prepared using a vibrating table with a surcharge and the modified Proctor procedure. RCC mixes studied contained 3.5 and 6 bags/cu ft of cement. Specimens prepared by using the vibrating table produced significantly lower densities and strengths because the moisture content was lowered. This paper appeared in Transportation Research Record No. 1136, Pavement Design.

In another investigation, a thickness design of roller-compacted concrete pavements was presented in this paper. The approach used for RCC pavements is similar to the procedure used by the Portland Cement Association for design of concrete airfield and heavy industrial pavements. The proposed procedure requires computation of permissible pavement stress based on the number of total load applications.
computation of expected pavement stress due to the design wheel load. A design thickness is selected such that the expected pavement stress is less than the allowable pavement stress. The proposed procedure is also applicable to mixed traffic loading. This paper appeared in Transportation Research Record No. 1136, Pavement Design.

The U.S. Army Corps of Engineers' pavement design procedures are particularly appropriate for low-volume road applications because they were developed from traffic tests using relatively low traffic volumes and thin pavement sections on low-strength subgrades. The large loads and low volumes of traffic used in their development are especially analogous to situations encountered in mining, logging, and similar industrial activities, or in port facilities. The flexible pavement criteria are appropriate for thin asphalt concrete pavements in granular base courses and subbases. Generally, rigid pavements have not been associated with low-volume roads because of their cost. However, development of roller-compacted concrete pavement construction has made rigid low-volume pavements feasible in many situations, and the Corps design method is capable of addressing roller-compacted concrete pavement characteristics. The design procedures, published in Army technical manuals, have also been computerized. The Corps of Engineers' design criteria can now be used quickly and efficiently, even by pavement engineers unfamiliar with Corps criteria or programs, to design economical pavements for military installations and other low-volume facilities. This paper appeared in Transportation Research Record No. 1128, Road Deterioration in Developing Countries and Low-Volume Road Engineering.
COORDINATION OF CONSTRUCTION
PRODUCTIVITY ADVANCEMENT RESEARCH (CPAR)
INTO THE PROGRAM OF THE CORPS OF ENGINEERS
NATIONAL ALTERNATE CONSTRUCTION
TECHNOLOGY TEAM (CENACTT)
COORDINATION OF CONSTRUCTION PRODUCTIVITY ADVANCEMENT RESEARCH (CPAR) INTO THE PROGRAM OF THE CORPS OF ENGINEERS NATIONAL ALTERNATE CONSTRUCTION TECHNOLOGY TEAM (CENACTT)

by

CONSTRUCTION RESEARCH CENTER GEORGIA INSTITUTE OF TECHNOLOGY ATLANTA, GEORGIA 30332-0155

May 1, 1990
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INTRODUCTION

The Construction Research Center (CRC), Georgia Institute of Technology was tasked by the U.S. Army Construction Engineering Research Laboratory (CERL) to provide planning support to the Corps of Engineers National Alternate Construction Technology Team (CENACTT). One of the tasks assigned to the CRC was to:

"Develop preliminary plans for coordinating the efforts of CENACTT so as to be complimentary to those of the Construction Productivity Advancement Research (CPAR) Program in the areas of common goals so as to avoid duplication of effort and maximize the return on investments."

The CPAR Program was initiated in Fiscal Year 1989 (FY89). At the present time, the first round of FY89 CPAR proposals, awards, and negotiations of Cooperative R&D Agreements (CDRA's) is complete. The second round of proposals for the FY90 program is currently underway; the proposal submission date was 15 March 1990. Therefore, sufficient information on the operation of the CPAR program should be available at this time to undertake a meaningful analysis of this CENACTT/CPAR coordination task.

BACKGROUND

1. The Corps of Engineers National Alternate Construction Technology Team (CENACTT)

The Corps of Engineers National Alternate Construction Technology Team (CENACTT) is one of the five Technology Transfer Test Beds (T3B) sponsored by the Military Programs Directorate and the Assistant Chief of Engineers Office of the U.S. Army Corps of Engineers (USACE). The mission of the CENACTT is to promote and aid in the transfer of research into actual practice. Additionally, CENACTT will aid the Corps' laboratories and the Headquarters, United States Army Corps of Engineers (HQUSACE) in testing and demonstrating new technology in the following areas:

- Building Systems, products and processes
- Road and Rail systems, products and processes
- Physical Security
The CENACTT team is also an advisor to HQUSACE on technology topics in the areas mentioned above. Thus, the team has the potential to influence the life cycle of the Corps' Research and Development (R&D) programs. The team's influence could extend from the start of a program through to the transfer of new products and technology to the user.

Members of the CENACTT come from HQUSACE, the Engineering & Housing Support Center (EHSC), Corps of Engineers Districts and Divisions, and Corps Laboratories. In the future, additional members are expected to join the team from various Army major commands and installations. The CENACTT team is the responsibility of the South Atlantic Division (SAD) located in Atlanta, Georgia.

Current CENACTT tests, demonstrations, and reports include:

- A report on a roller compacted concrete paving demonstration.
- A report on cracking, seating, and overlaying rigid pavement.
- A test to monitor and evaluate various exterior insulation products.
- A report on cathodic protection.
- A test to study various methods for the evaluation of physical security.
- A report on sand grids for use in soil stabilization.

The team's initial emphasis is on a productive test and demonstration program. To help in this effort, CENACTT is working with the Georgia Institute of Technology's Construction Research Center. Joint efforts are planned to include technology transfer and marketing of R&D products. CENACTT is one of the few Corps activities which has permanent members from the entire breadth of the Army Engineer family. The team expects to be a leader in guiding efforts to develop and introduce technology into all phases of facilities construction and maintenance.

2. The Construction Productivity Advancement Research (CPAR) Program

The purpose of the Construction Productivity Advancement Research (CPAR) Program is to assist the U.S. Construction Industry in enhancing its productivity and domestic and international competitive position through the development and reduction-to-practice of advanced technologies, materials and construction management systems. CPAR is a cost-shared partnership between the Corps of Engineers, the
U.S. Construction Industry (contractors, equipment and materials suppliers, architects, engineers, financial organizations), academic institutions, non-profit organizations and other groups who are interested in enhancing construction productivity and competitiveness. CPAR was created to help the Construction Industry regain its competitive edge nationally and internationally by building on the foundation of the existing Corps construction R&D program and associated laboratory resources through an expansion and leveraging effect that cost-shared partnerships provide.

The objective of CPAR is to facilitate research, development and application of advanced technologies through cooperative R&D, field demonstrations, licensing agreements and other means of technology transfer and reduction-to-practice. Advancing the productivity and competitiveness of the U.S. Construction Industry will provide savings in construction costs for the Government and U.S. industries, and result in a boost to the U.S. economy in general. R&D efforts conducted under CPAR are based on topics included in the Corps construction R&D program and topics suggested by the Construction Industry that can be effectively addressed by a partnership to benefit both the Corps and the Construction Industry.

Participation in CPAR is open to any U.S. private firm, including corporations, partnerships, limited partnerships and industrial development organizations; public and private foundations; academic institutions; non-profit organizations; units of State and local governments; and others who have interest in the capability to address CPAR objectives. Preference will be given to business units located in the United States that agree to substantially manufacture the products domestically.

The cost of each CPAR project will be shared by the Corps and the Construction Industry partners. "In-kind" services and the use of facilities may be considered in arriving at a cost-sharing agreement. As required by law, not more than 50 percent of the cost of a CPAR project will be provided by the Corps. The Corps may contribute personnel, services, facilities, property, intellectual property and money. The Construction Industry partners may contribute personnel, services, facilities, property, intellectual property and money.
Initially CPAR will focus on four major areas: design improvement, improved construction site productivity, advanced materials and technology transfer management. However, any ideas for improving construction productivity will be considered. Examples of major program areas in the CPAR program are listed in Figure 1.

**APPROACH**

It is apparent from the previous section that the CPAR program can contribute directly to the goals of the CENACTT. In order to maximize the potential benefits of this association, a five-part program should be considered:

1. **Establish Contact with all Laboratory CPAR Points-of-Contact (POC's).**

There are six Corps laboratories involved with the CPAR program. These laboratories and their principal areas of expertise are listed in Figure 2.

Each laboratory has a designated CPAR POC. Their principal responsibilities are:

- **Establish informal contact with the potential CPAR partner to ensure the correct laboratory has been contacted, and to ascertain the extent of Corps interest in a proposed research topic.**
- **Assist in the preparation of a complete and fully workable CPAR proposal.**
- **Represent the laboratory and the CPAR partners at the final review meeting of the HQUSACE Executive Committee.**
- **Assist in the preparation of a CDRA.**

As indicated above, during the course of their duties the laboratory POC's develop considerable knowledge about the content and merits of each CPAR proposal. Therefore, they could provide considerable assistance in determining which CPAR proposals have direct applicability to the CENACTT program. In addition, the CPAR POC's could identify selected proposals, not recommended for CPAR funding, which may also be of interest to the CENACTT. For example, of the 51 CPAR proposals recommended to the USACE Executive Committee by the laboratories in FY89, only 17 were funded. Some of the 34 non-funded projects which were submitted by the laboratories may also be worthy of CENACTT consideration.
MAJOR PROGRAM AREAS

DESIGN IMPROVEMENT:
- TOTAL INTEGRATED DESIGN SYSTEMS
- COMPUTER-AIDED ENGINEERING TOOLS
- COMPUTER-AIDED DESIGN SYSTEMS
- ADVANCED SITE INVESTIGATION TECHNOLOGY
- KNOWLEDGE-BASED COST SYSTEMS
- EXPERT SYSTEMS/ARTIFICIAL INTELLIGENCE
- MATERIALS SELECTION SYSTEMS

IMPROVED CONSTRUCTION SITE PRODUCTIVITY:
- COMPUTER-AIDED CONSTRUCTION
- AUTOMATED CONSTRUCTION/ROBOTICS
- AUTOMATED INSPECTION AND QUALITY CONTROL
- ADVANCED EXCAVATING AND TUNNELING
- MARINE CONSTRUCTION
- COLD WEATHER CONSTRUCTION
- CONSTRUCTION MANAGEMENT
- EXPERT SYSTEMS
- MATERIALS HANDLING

ADVANCED MATERIALS:
- HIGH-PERFORMANCE CEMENTITIOUS MATERIALS
- STRUCTURAL POLYMERS
- ADVANCED CERAMICS
- METAL MATRIX COMPOSITES
- COATINGS
- GEOMODIFIERS/GEOTEXTILES
- ADHESIVES/Fasteners

TECHNOLOGY TRANSFER MANAGEMENT:
- USER-BASED TECHNOLOGY TRANSFER PROCESS
- FIELD DEMONSTRATION PROJECTS
- TECHNICAL SUPPORT SERVICES
- PATENTS AND LICENSING AGREEMENTS
- SOFTWARE PACKAGES
- COURSES AND WORKSHOPS
- INFORMATION EXCHANGE SYSTEMS
- PARTICIPATION WITH SPECIFICATION AND BUILDING CODE ORGANIZATIONS
- COOPERATIVE R&D AGREEMENTS
WATERWAYS EXPERIMENT STATION
- STRUCTURAL AND GEOTECHNICAL DESIGN AND CONSTRUCTION TECHNIQUES
- HYDRAULIC PHENOMENA AND COASTAL ENGINEERING SYSTEMS
- TOXIC AND HAZARDOUS MATERIALS TECHNOLOGY
- COMPUTER-AIDED ENGINEERING AND INFORMATION TECHNOLOGY

CONSTRUCTION ENGINEERING RESEARCH LABORATORY
- BUILDING CONSTRUCTION, CONSTRUCTION MANAGEMENT
- COMPUTER-AIDED DESIGN AND MANAGEMENT
- TOXIC AND HAZARDOUS MATERIALS MANAGEMENT

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
- COLD WEATHER CONSTRUCTION (BUILDINGS, PAVEMENTS, FOUNDATIONS, SITE EXPLORATION, WASTE TREATMENT)
- REMOTE SENSING

ENGINEER TOPOGRAPHIC LABORATORIES
- SURVEYING AND MAPPING

HYDROLOGIC ENGINEERING CENTER
- HYDROLOGIC ENGINEERING AND MODELING

INSTITUTE FOR WATER RESOURCES
- ECONOMIC STUDIES, NAVIGATION ANALYSIS
2. **Become familiar with all funded CPAR projects.**

The CENACTT representative should personally review all funded CPAR projects to determine their applicability to CENACTT. Those which are determined to be within the purview of CENACTT should be identified for future monitoring. The 17 FY89 CPAR programs selected for funding are summarized in Appendix A.

3. **Prepare and distribute fact sheets on selected CPAR projects to CENACTT members.**

Each funded CPAR project identified as having potential CENACTT interest should be summarized and distributed to each CENACTT member. The CPAR POC's can provide Executive Summaries on each project. These could be used as a basis for the summaries. The CENACTT representative should also describe the relationship of the CPAR program to CENACTT. If appropriate, potential changes to the scope of work to make the research more directly applicable to CENACTT should also be noted on each project summary.

4. **Determine which CPAR programs should be adopted by CENACTT.**

At each CENACTT meeting the members should determine which CPAR programs should be adopted by the CENACTT. They should also develop specific recommendations to modify the Scope of Work to make the CPAR program more applicable to CENACTT interests if appropriate. These recommendations should be discussed with the appropriate CPAR POC to determine the extent to which they can be implemented.

5. **Monitor progress of adopted CENACTT programs.**

A progress report should be written on each adopted CPAR program and reported at each CENACTT meeting. If appropriate, this progress should be published in the CENACTT newsletter.

**SUMMARY**

1. A summary of the five part program outlined in this report is shown in Figure 3.

2. Coordination of selected CPAR research efforts with the CENACTT program would be mutually beneficial to both programs.
PRELIMINARY PLANS FOR COORDINATING CENACTT AND CPAR EFFORTS

• Establish contact with all CPAR points of contact

• Become familiar with all funded CPAR projects
  – Categorize into CENACTT areas of interest
  – Include programs of other services (NCEL, AFESC)

• Write fact sheets on CPAR projects relating to CENACTT interests
  – Distribute to CENACTT members

• Give oral & written CPAR status report at each CENACTT meeting
  – Add selected CPAR projects to the CENACTT program

• Report progress of CPAR program in CENACTT newsletter
a. CPAR would be assisted through CENACTT monitoring of the program to:
   (1) Make the program more responsive to Corps needs by recommending
       minor modifications to the work program, if appropriate.
   (2) Provide a CENACTT test bed to demonstrate and evaluate selected
       technological developments.
   (3) Assist in the technology transfer into the Corps of successful
       research products.

b. The CENACTT program would be enhanced as follows:
   (1) Make the CENACTT aware of new and emerging technologies at an
       early stage.
   (2) Recommend minor modifications to the work plan, as appropriate.
   (3) Combine CPAR and CENACTT demonstrations, tests and evaluations.
   (4) Join efforts in the technology transfer of successful research
       products.

RECOMMENDATIONS

1. The CENACTT develop a CPAR monitoring program as one of their official
   programs.

2. Assign a CENACTT member or organization to be responsible to:
   a. Develop a program along the lines given in the "APPROACH" section
      of this report.
   b. Act as the liaison between the CENACTT and the laboratory POC's
      of the CPAR program.
   c. Coordinate appropriate CPAR studies, demonstrations, tests, etc.
      with the CENACTT programs.

3. Join with CPAR government-industry-university partners in the technology
   transfer/commercialization of successful research products which have
   been selected for coordination with the CENACTT program.
1. Use of A High-performance Blended-cement System In Concrete Construction.

This two-year project will produce improved concrete for construction using Pyrament blended-cement concrete. According to the project’s industry partner and manufacturer, Lone Star Industries, the mixtures are stronger than current commonly used concretes, even at cold temperatures, and could shorten construction time, reduce repair time and lengthen the construction season into colder weather. The cement blends provided by the partner will be evaluated for durability and mixing, handling, placing and curing characteristics, and will be tested at extreme temperatures and in chemically aggressive environments. If proven superior, Pyrament-cement concrete will provide significant cost reduction and increased productivity in constructing and repairing airfields, highways and hydraulic structures.

Partners: U.S. Army Corps of Engineers Waterways Experiment Station and Lone Star Industries, Pyrament Division.

Cost: The Corps and industry partner will each contribute $200,000 per year for two years, for a total of $800,000.

2. Stabilization of Expansive Clay by Electro-osmosis

This 18-month project will provide a method to avoid expansive soil movements under existing buildings and pavements. Currently, there is no practical, reliable and inexpensive method for expansive clay stabilization. The project has its basis in the success of recent experiments and field application of electro-osmosis treatment using potassium chloride to stabilize expansive clays. Direct current with readily-available potassium chloride solutions will be used. The project will enable the stabilization of soils under existing structures, thus reducing long-term maintenance costs, and permitting new construction in expansive-soil areas at reduced construction costs.

Partners: U.S. Army Corps of Engineers Waterways Experiment Station and Home Owners Warranty Corporation.

Cost: The Corps and industry partner will each contribute $70 over three years, for a total of $140,000.

3. Application of Roller-compacted Concrete (RCC) Technology to Roadway Paving

This two-year project will demonstrate the use of RCC for roadway and overlay applications, study its structural
performance, and provide specifications for its use on pavements subject to high-speed traffic. RCC technology has already been proven successful and economical in both civil and military low-speed pavement applications. Its use for high-speed highway and airfield pavements will reduce pavement construction and maintenance costs.

Partners: The U.S. Army Corps of Engineers Waterways Experiment Station and Pennsylvania State University, Pennsylvania Department of Transportation, Ben Franklin Technology Center of Central and Northern Pennsylvania, Beaver Valley Builder Supply, Inc., Pennsylvania Power and Light, Forta Corporation, and Mitchell Fibercon, Inc.

Cost: The Corps will contribute $126,000 and the industry partners $255,000, for a total of $381,000.

4. Develop Computer Software To Determine Interdisciplinary Spatial Conflicts During Facility Design Using Input from Different Sources.

This one-year project includes the development of computer software that will detect inter-disciplinary spatial interference problems early in engineering design using 3-dimensional data from different sources. This will reduce construction cost over-runs and contractor claims, while providing more predictable project costs. It will also provide an audit trail and quality control document. The error-checking software will be compatible with computer hardware and software already owned by the Corps of Engineers, and other elements of the construction industry.

Partners: U.S. Army Corps of Engineers Waterways Experiment Station and Intergraph Corporation.

Cost: The Corps and industry partner will each contribute $146,500, for a total of $293,000.

5. Building Assemblies System (BAS)

This two-year project will test BAS, a prefabricated, panelized building system. The system will be adaptive to on-site assembly or factory pre-assembly (full or partial). BAS will use a modified version of systems already tested and installed in Europe. The system will be suitable for low-rise, small and large construction projects for housing and recreation, maintenance, administrative, operational and training facilities.


Cost: The Corps and industry partner will each contribute $125,000, for total of $250,000.
6. **Road Construction In Seasonal Frost Areas**

This three-year project will include construction of 40 instrumented road pavement test sections using both Portland cement and asphalt concrete that will be incorporated into a section of interstate highway northwest of Minneapolis, MN. Various pavement designs and procedures will be evaluated. Verification of improved design criteria developed in a cooperative venture between the Corps, the Federal Highway Research Administration and the Federal Aviation Administration will reduce roadway construction costs by reducing the thickness of the subbase and base courses, and also permit the use of lower quality materials.

**Partners:** U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory and Minnesota Department of Transportation.

**Cost:** The Corps will contribute $365,000 and the industry partner $4,155,000, for a total cost of $4,520,000.

7. **Robotically-assisted Masonry Construction**

This three-year project will develop robotic devices to assist skilled masons in construction projects. Masonry construction has a long history of injuries to its craftsmen who build with brick, block, stone and marble. Manufactured masonry units are getting larger and heavier. Robotics devices could be to alleviate the skeletal and muscular strain associated with handling and lifting heavy units, allowing masons to do a greater volume of work without tiring, and enjoy a longer working life expectancy. Robotic assistance is expected to offset the costs of injury and insurance for individual masons, which can be as high as $3 million, and enhance productivity.

**Partners:** U.S. Army Corps of Engineers Construction Engineering Research Laboratory and the International Masonry Institute.

**Cost:** The Corps will contribute $189,000 and the industry partner $195,000, for a total cost of $384,000.

8. **Improved Materials and Processes for Sealing and Resealing Joints in Pavements**

This three-year project will evaluate various pavement sealants to solve problems associated with hot-applied sealants becoming brittle in cold weather, and the bubbling of hot-applied sealants because of moisture or chemical reaction with the pavement. Application methods will also be tested to extend the working life of sealants. Field testing will be done in different climates. Improved sealants will extend pavement life and reduce maintenance costs.
Partners: U.S. Army Corps of Engineers Waterways Experiment Station and Crafco, Inc.

Cost: The Corps and industry partner will each contribute $219,000, for a total of $438,200.


This one-year project will produce a low-cost personal computer-based software system that would reduce the time and cost for construction contractors to comply with the OSHA Hazardous Communications Standard (HCS). It will be designed to provide a simple method to train workers in the OSHA standards, keep records of training and generate reports, resulting in increased productivity and cost savings.

Partners: U.S. Army Corps of Engineers Construction Engineering Research Laboratory and Northeast Louisiana University, Associated Builders and Contractors, Pelican Chapter Training Center, and Associated General Contractors, Louisiana Chapter.

Cost: The Corps and industry partners will each contribute $23,000, for a total of $46,000.

10. Rapid Method To Determine Freeze-thaw Resistance of Aggregate

This is a two-year project will determine the freeze-thaw durability of aggregate used in making concrete. Over the past 35 years, the Michigan Department of Transportation has observed a strong correlation between concrete pavement performance and aggregate source. Data from the 35-year study will be used to develop new test methods and equipment for on-site testing of aggregate. Promising test procedures will be demonstrated in field tests. The new procedures will reduce the time needed to evaluate aggregate sources from several months to several days, reducing testing costs and enhancing job productivity.

Partners: The U.S. Army Corps of Engineers Cold Regions Research Engineering Laboratory and Michigan Department of Transportation.

Cost: The Corps and industry partner will each contribute $90,000, for a total of $180,000.

11. Construction of Soil Liners for Landfills, Hazardous Waste Containment and Disposal Sites in Cold Regions

This two-year project will develop improved soil liners and caps, and identify and develop soil-based materials to extend
construction seasons for sanitary and hazardous waste landfills in cold regions. Soil stabilizer and modifier use with soil liners could result in a decrease in the thickness of the liner and increased site productivity. Also, soil modifiers could allow construction to continue in adverse weather and save construction costs.

Partners: The U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory and Browning-Ferris Industries, CH2M Hill, and Oregon State University.

Cost: The Corps and industry partners will each contribute $230,000, for a total of $460,000.

12. Computer Software for On-line Process Control of Portland Cement Concrete Production

This two-year project will develop a computer program, Smart Plant, for batch plant control which will reduce the cost of concrete mixtures, minimize the adverse effects of material and mixture variations and increase concrete construction productivity. The data base will accommodate information provided by manual input, on-line production sampling and testing and field information taken from quality assurance reports. Results will be tested in the laboratory, the field and at a Corps project site. Benefits include reduced concrete materials and mixture costs and greater site productivity by avoidance of delays due to mixture variations.

Partners: U.S. Army Corps of Engineers Waterways Experiment Station and Shilstone Software Co.

Cost: Corps will contribute $380,000 and the industry partner $758,000, for a total of $1,138,000.

13. Development and Use of Corrosion Resistant Modified Sulfur Concrete Structural Components

This 18 month project will develop new designs, techniques, procedures and specifications for using modified sulfur concrete (SC) in constructing and repairing heavy load-bearing surfaces such as floors, bridges, roads, runways and other structural components subject to hostile chemical environments. Research and development by the U.S. Bureau of Mines and the Sulphur Institute has proven the effectiveness of SC in floors, walls and sumps in a highly corrosive environment. The project would test SC's effectiveness in the demanding structural engineering field. Extended life-cycle performance and reduced maintenance costs are expected benefits, as well as reduced construction time because of the rapid-setting property of SC.
Partners: The U.S. Army Corps of Engineers Waterways Experiment Station and National Chempruf Concrete, Inc.

Cost: The Corps will contribute $45,000, and the industry partner $55,000, for a total of $100,000.

14. Asphalt-rubber Concrete Criteria for Mix Design and Applications

This two-year project will evaluate Asphalt-Rubber for widespread use as a binder in concrete. Combining scrap tire rubber and asphalt cement, it has been used in spray applications to control reflective cracking and provide waterproof membranes. Technology now exists to evaluate Asphalt-Rubber as a binder. Asphalt-Rubber's use as a binder will improve performance, reduce maintenance, extend pavement life, reduce pavement thicknesses and have a significant effect on the total productivity of the paving industry.


Cost: The Corps and industry partners will each contribute $150,000, for a total of $300,000.

15. Advanced Construction Technology System (ACTS)

This two-year project will expand the Construction Industry Institute’s Advanced Construction Technology System beyond its current architectural and structural fields to include new technologies in the electrical, mechanical and civil fields. ACTS currently contains 151 advanced construction technologies. By expanding and improving the system, identification and acceptance of new technologies will be encouraged, thus increasing productivity in the construction industry.

Partners: The U.S. Army Corps of Engineers Construction Engineering Research Laboratory and Construction Industry Institute at the University of Texas at Austin.

Cost: The Corps will contribute $75,000 and the industry partner $105,000, for a total for $180,000.


This nine-month project will develop an asbestos destruction procedure that is pollution free and cost effective. The project will test the concept that plasma arc technology can melt asbestos and asbestos-containing materials into a harmless residue, and develop a process for a furnace system contained on a mobile trailer unit for on-site destruction of asbestos-containing materials.
Partners: The U.S. Army Corps of Engineers Construction Engineering Research Laboratory and Georgia Institute of Technology, Georgia Tech Research Institute, Asbestos Abatement Technology, Inc., and Plasma Energy Corporation.

Cost: The Corps and industry partners will each contribute $35,000, for a total of $70,000.

17. Development of a Heating, Ventilation, and Air-conditioning (HVAC) Simulation and Balancing Tool

This one-year project will develop a simulation tool which will shorten the time required to design and balance HVAC duct systems. The proposed simulation tool would provide installers with a good estimate of the damper and fan settings needed to properly balance the HVAC system. It would also give them information on changing mechanical settings for specific flowrates and/or pressures. In addition, the proposed tool would preclude the need for design changes after installation, and result in significant savings in construction costs and change orders.

Partners: U.S. Army Corps of Engineers Construction Engineering Research Laboratory, and Bechtel National, Inc.

Cost: The Corps and industry partner will each contribute $64,000, for a total of $128,000.
This is the first issue of a newsletter under the sponsorship of the Corps of Engineers National Alternate Construction Technology Team (CENACTT). This team is one of five Technology Transfer Test Beds (T3B) sponsored by the Engineering and Construction Directorate and the Assistant Chief of Engineers Office of the U.S. Army Corps of Engineers.

The mission of the CENACTT team is to promote and aid in the transfer of research into actual practice. Additionally, CENACTT will aid the Corps’ laboratories and Headquarters United States Army Corps of Engineers (HQUSACE) in testing and demonstrating new technology in the following areas.

- Building Systems, products and processes
- Road and Rail systems, products and processes
- Physical Security
- Electromagnetic Effects
- Corrosion Control and Protection

The CENACTT team is also an advisor to HQUSACE on technology topics in the areas mentioned above. Thus, the team has the potential to influence the life cycle of the Corps’ Research and Development (R&D) programs. The team’s influence could extend from start of a program through to the transfer of new products or technology to the user.

Members of the team come from HQUSACE, the Engineering & Housing Support Center (EHSC), Corps of Engineers Districts and Divisions, and Corps Laboratories. In the future, additional members are expected to join the team from various Army major commands and installations. The CENACTT team is the responsibility of the South Atlantic Division (SAD) located in Atlanta, Georgia. The co-chairmen are C. Pat Davis from SAD (CESAD-EN-T) and Donald R. Dressler from the Engineering and Construction Directorate (CEEC-ED), U.S. Army Corps of Engineers.

Current CENACTT tests, demonstrations, and reports include.

- A report on a roller compacted concrete paving demonstration.
- A report on cracking, seating, and overlaying rigid pavement.
- A test to monitor and evaluate various exterior insulation products.
- A report on cathodic protection.
- A test to study various methods for the evaluation of physical security.
- A report on sand grids for use in soil stabilization.

The team’s initial emphasis is on a productive test and demonstration program. To help in this effort, CENACTT is working with the Georgia Institute of Technology’s Construction Research Center. Joint efforts are planned to include technology transfer and marketing of R&D products as well as:

- The publishing of this newsletter.
- Coordinating CENACTT’s efforts with the Corps’ new Construction Productivity Advancement Research (CPAR) Program.
- Development of a conceptual plan for a Corps Technology Transfer and Information Retrieval Center.
Finally, CENACTT is one of the few Corps activities which has permanent members from the entire breadth of the Army Engineer family. The team expects to be a leader in guiding efforts to develop and introduce technology into all phases of facilities construction and maintenance. Any alternate construction technology articles, comments, or ideas for this newsletter should be submitted to:

Commander, US Army Corps of Engineers
South Atlantic Division
ATTN: CENACTT (CESAD-EN-T)
77 Forsyth Street
Atlanta, GA 30335-6801

Sand Grids For Soil Stabilization

Sand grid confinement is a new concept for soil stabilization developed at the U.S. Army Engineer Waterways Experiment Station (WES). The concept was initially developed for constructing military roads across unstable soils in areas where conventional construction aggregates were not locally available. The process involves the confinement of sand or sandy materials in a honeycomb arrangement of plastic grid cells. This produces a load-distributing pavement base layer. For road applications, a sand-asphalt surfacing is incorporated within the top portion of the sand-grid cells. When applied over a sand-asphalt subgrade, a sand-surfaced road is capable of supporting more than 10,000 passes of truck traffic. This includes tandem axle loads of up to 53,000 lbs. For higher volume traffic, conventional bituminous surface courses can be installed over the sand-grid layer.

The plastic honeycomb grid panels are made from sheet high-density plastic polyethylene. The grid is shipped in collapsed panels and can be easily expanded for field use. Grid panels are supplied with either 8-inch or 4-inch deep cells. Each collapsed grid panel is 5 inches thick and expands to form a honey comb arrangement of 561 cells. Once expanded, a panel fills an area 8 feet by 20 feet. The plastic strips forming the cells are connected by ultrasonic welds at 13 inch spacings. A grid panel containing 8-inch deep cells weighs 114 lbs.

Additional WES research with sand grids has lead to its use in runway bomb damage repair and in military revetments. Successful commercial applications have included airfield and highway construction. Sand grids have also been used successfully in retaining walls, low water crossings, rail track stabilization, ditch linings, slope erosion control, boat ramps, stream bank reconstruction, and grass parking lots.

A demonstration project with the Mobile District using sand grids for soil stabilization is in progress at Fort Rucker, AL.

- Contributed by Steve L. Webster of WES.
Phone (601) 634-2513
Asphalt Concrete Overlays

Reflective cracking of asphalt concrete overlays on portland cement concrete pavements (PCCP) has been a major concern of engineers for many years. A number of different techniques have been developed and tested to reduce, control and eliminate the reflective cracks. In September 1987, the Mobile District, Corps of Engineers was faced with the dilemma of choosing among the various techniques to combat reflective cracking on a project in Florida. This project originally called for a simple asphalt concrete overlay of nearly 16,000 square yards of portland cement concrete pavement. After consultation with the Florida Department of Transportation, the Mobile District chose the innovative technique known as "cracking and seating".

Cracking and seating is a construction technique where the PCCP is mechanically cracked to distribute horizontal stresses over a large area. The pavement is then firmly seated on the subgrade to minimize vertical movement. Instead of the pavement expanding or contracting in one large monolithic flow from control joint to control joint, it now acts as smaller sections of concrete. Less movement occurs at each of the induced hairline crack locations, therefore reducing the number of reflections in the asphalt.

The Mobile District project used a type of cracking equipment known as a whiphammer. The whiphammer is a truck-mounted one-man operation, consisting of a series of bolted slats with a steel hammer attached to the end. After cracking, the pavement was seated on the subgrade with a 25-ton pneumatic tire roller. The cost to crack and seat the PCCP on this project was $1.65 per square yard and can be expected to vary from region to region. Since the completion of the project, over one and a half years ago, no reflections have been detected in the asphalt.

The potential of the cracking and seating technique to reduce reflective cracking is unlimited. The technique could be used on airfields, parking lots, roadways or any other projects concerned with reflective cracking of asphalt concrete overlays. To date, the procedure has proven to be a cost effective and feasible alternative in pavement maintenance. For more information concerning this project and the use of cracking and seating, contact Larry Dorsey with the Mobile District of the Army Corps of Engineers, Mobile, Alabama. (205-690-2603)

Roller Compacted Concrete Pavement

The Savannah District of the Corps of Engineers recently utilized roller compacted concrete in the construction of one of their projects in the first usage of this technique in the southeastern United States. The project at Fort Benning, Georgia consisted of 33,500 square yards of hardstand pavement. Of this total, 23,630 yards of the project was selected to have Roller Compacted Concrete to reduce the overall cost of the project.

Since this was the first application of roller compacted concrete in the Southeast, HQUSACE provided funds to allow a demonstration project to be conducted. The demonstration was held in November 1986 and proved to be very beneficial. Both the Savannah District and the sub-contractor for the RCC work were able to see first-hand the scope of the work required to meet specification requirements.

The project specifications and emplacement procedures required that special mixing equipment be used to obtain a concrete pavement with a flexural strength of 650 psi. Consequently, a ARAN ASR 280 Model B concrete mixing plant had to be shipped from Australia and trucked to the project at Fort Benning. This mixing plant is a portable and continuous mixing type capable of producing over 400 tons of mixture per hour. The batching plant had to be located close to the project because the RCC required a low consistency and moisture content plus have final rolling of the placed mixture within 45 minutes of the start of the mixing of the concrete components. Additionally, any further water evaporation of the concrete during transportation had to be minimized.

Placement of the roller compacted concrete was similar to that of hot asphalt pavement. The RCC zero slump mixture was placed into a modified conventional asphalt laydown machine. A Roadtec 465 Paver-Finisher with a variomatic screed and single full width tamper bar was used in this application. Operations with this machine generally achieved densities of 86 to 88 percent of the maximum density.

Rolling and curing operations of the RCC began ten minutes after placement. A 10 ton Dynapac CC42 Series Two vibratory roller was used to compact the concrete. After compaction to 98 percent density, the surface was finished with an 8 to 10 ton static dual steel drum and rubber tire traffic roller. The completed segments of RCC were kept continuously wet by a water spray truck for 24 hours.
After this initial curing, the RCC pavement was kept moist by the water spray truck for an additional 7 days.

Due to the low moisture content and method of placement, the RCC has a rough surface texture. However, this characteristic in no way affects its strength. The cost effectiveness of the RCC for this project was $14.55 per square yard versus $21.78 for conventional concrete. The lower cost of the RCC pavement makes it ideal for continued use in military construction for such projects as tank trails, turnstands, hardstands, and certain designated airfield pavements.

Results of this RCC paving project as well as the project considerations have been documented in a CENACTT report and distributed to all Corps districts, divisions, and laboratories. Copies of the report may be obtained from Joe Rogers, Chief, Geotechnical and Materials Branch, Savannah District. Phone (912) 944-5255.

Ceramic Anodes For Corrosion Protection

For years, corrosion of metallic structures buried in soil or immersed in water has been stopped through the use of cathodic protection — the application of a small electric current from an outside source to the metallic structure. The current is applied through an anode, which is eventually consumed by the current.

For the past 30 years, primarily two materials, silicon-iron and graphite, have been used to provide cathodic anode protection. However, these materials are brittle and have consumption rates on the order of one pound per ampere year. Consequently, large, intricate anodes are necessary. But, these large anodes are plagued with installation and application problems. Large anodes are also vulnerable to debris and ice damage. These problems contributed to a reliability of only 20 percent for Corps of Engineer applications.

A recent breakthrough at USA-CERL, however, produced a ceramic anode. The ceramic anode now gives the Corps of Engineers a cost effective way to combat corrosion in high-volume, low-cost materials applications. One ampere of current supplied to the ceramic anode can stop corrosion on 500 square feet of uncoated steel. The ceramic anode makes corrosion protection available at one-half the life cycle cost of previous technologies and in a size reduction that permits installation in areas previously considered too small.

The consumption rate of conducting ceramic materials such as metal oxides is 500 times less than the currently used silicon-iron and graphite anodes. This results in an anode that is much smaller (50 times by weight) and has the same life. The ceramic anode also has a factory fabricated and tested redundant electrical connection. This connection eliminates installation problems associated with silicon-iron and graphite anodes and results in positive electrical isolation between the anode and the structure. In addition, the ceramic anode is resistant to mechanical damage from floating debris due to the tough anode substrate and protective design features. All of these factors increase the cathodic protection system reliability from 20 to a potential 90 percent when ceramic anodes are used.

Ceramic anodes have been installed on water towers at Fort Ord, CA and Fort Hood, TX. Underground pipes at Fort Monroe, VA have been protected by canister-type ceramic anodes and a contract has been awarded to install ceramic anodes at Fort Lee, VA to protect underground fuel tanks. Complete cathodic protection systems using ceramic anodes developed by USA-CERL have also been installed on numerous water projects. The tainter (dam) gates at the Cordell Hull Dam, Cape Canaveral Lock gates, miter gates at Pike Island and other projects within the Corps of Engineers have all had good results with ceramic anodes.

The ceramic anode developed by USA-CERL has won various awards. In 1984, the ceramic anode won the Army Research and Development Achievement Award and the Army Science Conference Award for Outstanding Achievement. In 1985, it was awarded the IR-100 Award by Research and Development Magazine.

Questions concerning the use and applications of ceramic anodes can be directed to Dr. A. Kumar, at 217-373-7235 or, Mr. V. Hock, at 217-373-6753. Both individuals may be reached at AUTOVON 862-1110 or call toll free 800-USA-CERL.