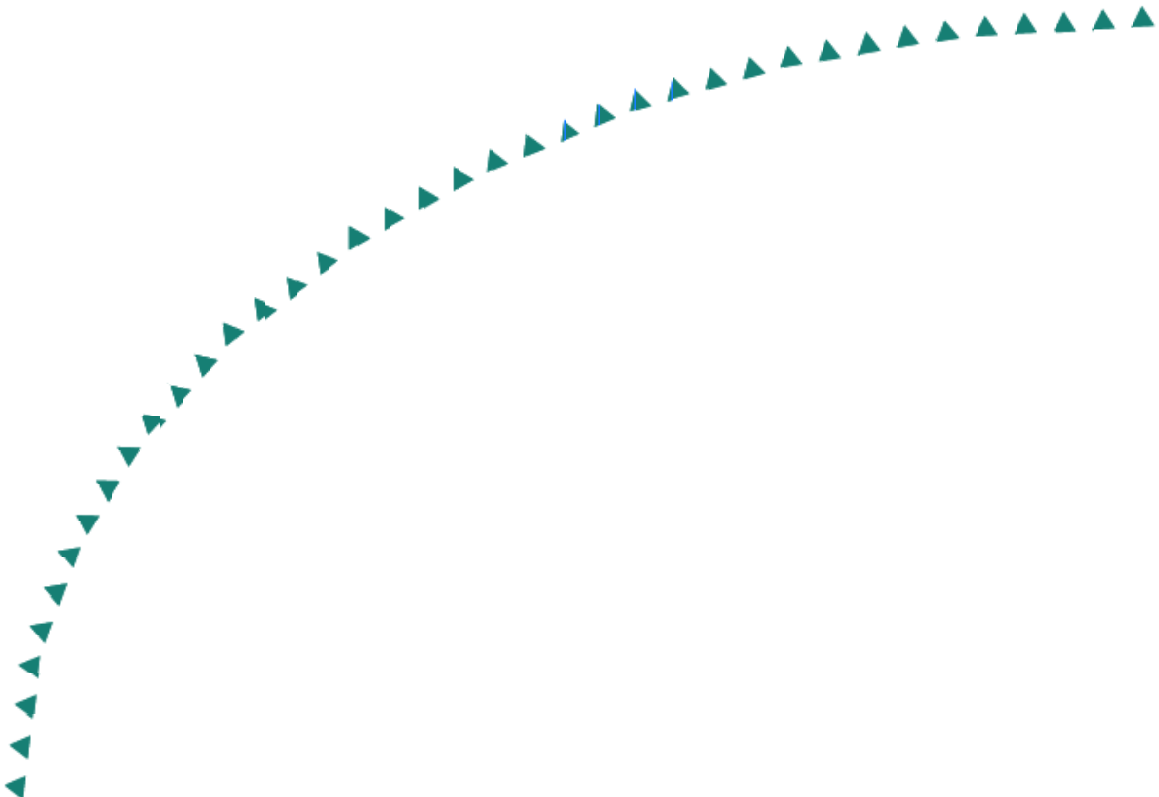
2005-34

Final Report

Best Practices for Project Construction Streamlining



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Recent initiatives at the state and federal level have focused attention on possible ways of streamlining or expediting the project delivery process. While some of these efforts have focused on methods and practices to speed planning and pre-construction activities, the purpose of this investigation was to examine means of speeding the roadway and highway construction cycle. Highway construction time has very real costs to all parties involved in the process; highway departments, contractors, and most especially the public whose tax dollars and time is spent waiting for projects to be completed. Recognizing this, the Local Road Research Board's (LRRB) Research Implementation Committee (RIC) began this investigation to explore current activities, techniques and materials whose use reduces construction time, and to determine the extent of their use by city and county engineers in Minnesota.

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Best Practices for Project Construction Streamlining

Final Report

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SRF Consulting Group, Inc.

September 2005

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Minnesota Department of Transportation
Research Services Section
395 John Ireland Boulevard, Mail Stop 330
St. Paul, Minnesota 55155

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Rick Kjonaas, Mn/DOT State Aid, Chair
Gary Bruggeman, Steele County
John Grindeland, Fillmore County
Roger Gustafson, Carver County
Karl Keel, URS Corporation
Mike Martilla, Mn/DOT
Mark Melby, Crow Wing County
Lyndon Robjent, Anoka County
Jodi Teich, Stearns County
Dan Warzala, Mn/DOT
Joel Williams, Mn/DOT

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report identifies project construction streamlining techniques that have been used in Minnesota and presents information on best practices based on interviews with practitioners.

Techniques surveyed include:

- Smart Compaction Technology
- New Testing Devices
- Quality Contract Awarding
- Contractor Milestone Incentives
- Value Engineering
- Road or Lane Closure
- Oscillatory Compactors
- Design-Build
- A + B Contracting
- Performance-Rated Specifications
- Utility Relocation
- Lane Rental

In addition, a variety of other potential construction streamlining techniques are identified as part of a secondary review of strategies. A literature review was conducted and abstracts from these sources are included as an appendix to this report providing information on these secondary strategies.

CHAPTER 1: INTRODUCTION

Task Background and Purpose

Recent initiatives at the state and federal level have focused attention on possible ways of streamlining or expediting the project delivery process. While some of these efforts have focused on methods and practices to speed planning and pre-construction activities, the purpose of this investigation was to examine means of speeding the roadway and highway construction cycle. Highway construction time has very real costs to all parties involved in the process; highway departments, contractors, and most especially the public whose tax dollars and time is spent waiting for projects to be completed. Recognizing this, the Local Road Research Board's (LRRB) Research Implementation Committee (RIC) began this investigation to explore current activities, techniques and materials whose use reduces construction time, and to determine the extent of their use by city and county engineers in Minnesota.

Study Process

The study process consisted of the following activities:

1. Literature Review: The intent of the literature review was to discover the range of possible construction streamlining techniques, of what they consisted and how they worked.
2. Technique Categorization: In this step, streamlining techniques were identified as being one of two levels; Level 1 techniques are those with some likelihood for immediate application and drawn from Minnesota experience; Level 2 techniques are those with merit but no local experience.
3. Initial Survey of Minnesota City and County Engineers: This initial survey was intended to determine the depth of experience of engineers in Minnesota in using the Level One construction streamlining techniques.
4. Follow-Up Survey of Minnesota City and County Engineers: This follow-up survey was intended to gather information from engineers with experience using the streamlining technique and to determine any benefits or drawbacks, the depth of experience, and the type of project for which it was most useful.
5. Review and Categorize Level 2 Techniques: This was accomplished by conducting a more intensive literature review focused on the specific techniques identified as a result of the initial literature review. Abstracts of interest are collected in Appendix A of this report.

The report is organized into the following sections: Chapter 2 summarizes results of the literature review, Chapter 3 looks at specific project construction techniques, and Chapter 4 presents the results of surveys designed to gauge the depth of experience in Minnesota in using the techniques. Appendix A of this report contains abstracts from research articles directing a reader to more in-depth sources of information about the techniques identified.

CHAPTER 2: LITERATURE REVIEW

The first step in the process of understanding the project construction streamlining activities used in Minnesota was to develop an understanding of the potential techniques available to engineers and contractors. This was accomplished by undertaking a comprehensive literature review on the state of the art and practice.

As mentioned previously, the subject of streamlining and/or expediting project construction is one that has generated much attention in recent history. The literature review uncovered numerous sources of information. One of the most important first steps in the investigation was to categorize the various techniques in order to present information in an organized and comprehensible fashion. It would be presumptuous to imply that this literature review and the process of categorization captured all possible techniques and developed a hierarchy of categorization that can be universally applied regardless of circumstances. Rather, the information that follows was believed to be that which best suited the specific circumstance for this particular investigation.

Streamlining Categories

For this study, project construction streamlining techniques have been categorized, in no particular order, as follows:

- Equipment Innovations
- Construction Processes
- Contractor/Contracting Processes
- Utility Relocation Processes
- Advanced Technology Applications
- Human Resource Innovations
- Materials Usage

CHAPTER 3: PROJECT CONSTRUCTION STREAMLINING TECHNIQUES

Project construction streamlining techniques are summarized below by category along with a brief description of what the technique entails. Readers desiring more detailed information on each technique are directed to Appendix A, which contains abstracts from articles published on the subject.

Understanding that not all potential methods or practices were advanced to the point of being applicable or appropriate for implementation in Minnesota, the Technical Assistance Panel (TAP) convened for this task decided to sort identified techniques into two categories; Level 1 and Level 2. Level 1 techniques were identified as those with the some likelihood of immediate implementation in Minnesota local governments while Level 2 techniques were those that were of merit but with little likelihood for local experience.

After an initial sorting of information uncovered in the literature review, the TAP convened to review the results and give input into sorting techniques into Level 1 and Level 2 categories. They identified the following categories.

3.1 LEVEL ONE TECHNIQUES

Level 1 techniques are summarized below. These techniques were used as the basis to craft a follow-up survey designed to determine the nature and extent of Minnesota City and County engineers' experience in implementation. The definition of the techniques is found below, with information from the follow-up survey on Minnesota experience to follow.

Equipment Innovations

- *Smart Compaction Technology:* Smart compaction technology uses a device that measures stiffness while the compactor is in motion and automatically adjusts compaction pressure based on readings of soil conditions.

- *Oscillatory Compactors:* Unlike traditional vibratory compactors that achieve compaction by bouncing the drum on the ground, oscillatory compactors ensure that the roller drum maintains constant contact with the ground for faster, more effective compaction.

- *New Testing Devices:* New testing devices that reduce laboratory testing include ground-penetrating radar measuring air voids or density of pavements, light-weight deflectometers measuring compaction, devices that provide instantaneous readings of soil moisture, and nuclear-density testing to measure compaction.

Construction Processes

- *Design-Build:* Design-build is an alternative to the traditional Design-Bid-Build system, with the difference being that the design and construction duties are performed concurrently by the same team. It can take various forms, such as: Bridging, when the owner develops the primary project design to the 30-50 percent level; Turnkey, when the

owner requires outside expertise and then allows the entity to turn over the keys at project completion; Design-Build-Warranty, which combines a warranty provision with Design-Build; Design-Build-Maintain, which combines maintenance activities with Design-Build; and, Privatization, when a private entity designs, builds, and maintains a section of roadway in return for a toll or fee.

Contractor/Contracting Processes

- *Quality Contract Awarding*: A process whereby the contract award mechanism focuses on and accounts for quality and ability, not just "least cost."

- *A+B Contracting:* A+B contracting (also called cost plus time) is a procedure that incorporates the lowest initial cost but also factors into the selection process the time to complete the project.

- *Contractor Milestone Incentives:* Uses contractor milestone incentives to financially award contractors for on-time delivery of specific tasks and/or products.

- *Performance-Rated Specifications*: Rather than telling builders and suppliers how to build a project, they would be given a description of what the end product must "look like," in terms of performance standards. The standards should be based on the needs of motorists, such as pavement smoothness levels, safety criteria, and the like. Then, working together, the transportation agency, the contractors, and the suppliers can devise innovative ways of getting the job done.

- *Value Engineering*: Value engineering is a process allowing the identification and selection of the best value alternative for designs, materials, processes, systems, and program documentation. It can apply to hardware and software; development, production, and manufacturing; specifications, standards, contract requirements, and other acquisition program documentation; facilities design and construction; and management or organizational systems and processes.

Utility Relocation Processes

- *Utility Relocation:* Places greater responsibility on contractor for dealing with utilities as part of the construction contract.

Traffic Control / Construction Staging

- *Road or Lane Closure:* A practice in which lanes or entire facilities are completely closed to traffic during construction in order to save construction time.

- *Lane-Rental*: An approach whereby contractors are charged for closing down lanes with an incentive to speed construction time.

3.2 LEVEL TWO TECHNIQUES

Level 2 techniques are summarized below. Given direction from the TAP regarding the likelihood and merit of conducting follow-up surveys on these techniques, information regarding Level 2 techniques is summarized in Appendix A.

Equipment Innovations

- *Automated Pavement Testing Technologies:* The use of automated pavement testing technologies allows for in-the-field testing of asphalt and automatic modification of the mix based on testing results.
- *Double-Drum/Triple-Drum Mixers:* Using double- or triple-drum mixers allows for faster, more thorough drying of aggregates.

Human Resource Innovations

- *Incentive Pay:* Create incentive pay for road agency personnel encouraging retention of highly-skilled project managers in effective positions.

- *"Streamline" Project Development:* Uses a "streamlined" project development process, in which the same project manager follows a project through from planning to design to construction management.

Materials Usage

- *Drying Agents:* Uses drying agents like cement lime or fly ash so that soils can be worked more quickly.

- *In-Place Recycling:* Uses in-place recycling as a means of shortening the construction process by reducing the time to transport materials. (Full-depth reclamation or cold-in-place recycling.)

- *Geo-Textiles or Geo-Fabrics*: These fabrics are used in lieu of more time-consuming sub-grade preparations, allowing rapid placement of the granular base and leading to quicker pavement installation.

Construction Processes

- *Pre-Cast / Modular Components:* Construction zones can maximize concurrent work activity with the use of modular, prefabricated components. Precast modular components such as bridge sections or road slabs are common examples.

Advanced Technology Applications

- *"Smart" Database Creation:* This type of database would contain productivity rates for different construction methods and can be used by project managers to provide better information on scheduling or projects.

- *Web-Based Team Collaboration System:* Web-based project management systems eliminate any apparent boundary between a project participant's computer and project's folders and files. They can be as simple as a common e-Room or as complex as web-based central project databases, business-to-business capabilities, and intelligent software agents. Improving communications may speed the construction process.

- *Project Management Software:* Use of project management software in general may expedite construction time by more efficient tracking of project progress, schedule adherence, allocation of staff time and resources, and correspondence management activities.

- *Bid-Preparation Software:* The use of bid-preparation software speeds the process of bid letting.

CHAPTER 4: MINNESOTA CITY AND COUNTY ENGINEERS' SURVEY

After the TAP identified Level 1 and Level 2 techniques from the literature review, they developed a survey of Minnesota City and County Engineers. The survey process was designed in two phases, with the first phase intended to identify agencies with experience using the technique and the second phase intended to glean more in-depth experience from the practitioners. The survey process only dealt with Level 1 techniques; Level 2 techniques, or those of secondary interest, are summarized in abstract form in Appendix A.

Initial Survey

The first survey was a mail-back questionnaire surveying each of the Minnesota County and City Engineers to determine who had experience and identifying a contact person for a follow-up interview. A total of 53 responses were received. Responses for each Level 1 technique are summarized below. By far, the greatest number of responders (32) indicated they had experience closing entire roadways or lanes during construction in order to speed the process. The technique with the next highest number of responders was making contractors more responsible for the utility relocation process (24 responders) and using value engineering (16 responders).

Topic Area	Streamlining Activity	Number of Engineers with Direct Experience	Number Indicating Experience Successful
EQUIPMENT INNOVATIONS	1. Smart Compaction Technology	None	None
	2. Oscillatory Compactors	0	0
	3. New Testing Devices	14	13
CONSTRUCTION PROCESSES	4. Design-Build (in any form)	8	8*
CONTRACTOR / CONCTRACTING PROCESSES	5. Quality Contract Awarding	5	5
	6. A+B Contracting	4	4
	7. Contractor Milestone Incentives	4	4
	8. Performance-Rated Specifications	8	7
	9. Value Engineering	16	16
UTILITY RELOCATION	10. Utility Relocation	24	18
TRAFFIC CONTROL / CONSTRUCTION STAGING	11. Road or Lane Closure	32	31
	12. Lane-Rental	2	2

Follow-Up Survey

A follow-up survey was sent via e-mail to all responders of the first survey indicating experience with one or another streamlining technique. This follow-up survey was unique to the technique, so that responders indicating experience with more than one technique were sent one survey for every technique for which they had experience.

These follow-up surveys were intended to discover more information about the depth of experience of Minnesota City and County Engineers with the construction streamlining technique, any benefits or drawbacks associated with its use, and the type of project for which it may be most appropriate. Information from the follow-up survey is summarized in the following pages, with a general definition offered for each, and other information summarized from the survey.

Construction Processes

<table>
<tr><th colspan="2">Design-Build</th></tr>
<tr><td colspan="2">Definition: Design-build is an alternative to the traditional Design-Bid-Build system, with the difference being that the design and construction duties are performed concurrently by the same team.</td></tr>
<tr><td>Number of Survey Responders: 2</td><td>Depth of Experience: Design-Build has been used on five Mn/DOT projects; Hiawatha LRT, ROC 52, I-494, TH 10/32 and TH 212.</td></tr>
<tr><td>Applicability:
This process is not applicable where there may be a great deal of risk placed on contractors. Due to the procurement time of the existing process, small projects (<$8,000,000) with a short duration (<one construction season) are not appropriate. A different process could be used.</td><td>Drawbacks:
No Response</td></tr>
<tr><td>Potential Obstacles:
It requires new legislation</td><td>Lessons Learned:
“Research what other agencies are doing in this area, know what you are getting into and work with the contracting community to get buy in.”</td></tr>
</table>

Design-Build (cont.)

Topic Resource:

Joseph Gladke
Design-Build Program Director
Office of Construction and Innovative Contracting, MS 687
395 John Ireland Blvd.
St. Paul, MN 55155
651-296-3283

Contractor/Contracting Process Techniques

Quality Contract Awarding

Definition: Quality contract awarding allows a jurisdiction / agency to account for quality and ability when awarding a contract, and not accept the low-cost bidder alone.

Number of Survey Responders: 3

Depth of Experience: More than 10 years (combined for all responders)

Benefits:

- Reduced user costs, use of Alternative Technical Concepts from other proposers, and we determine who is the best value contractor, not just the low bid.

Applicability:

- We are currently only allowed to conduct best value selection on design-build construction projects. Due to the procurement time of the existing process, small projects (<$8,000,000) with a short duration (<one construction season) are not appropriate.

Drawbacks:

- No Response

Potential Obstacles:

- It requires new legislation

Lessons Learned:

- "Research what other agencies are doing in this area, know what you are getting into and work with the contracting community to get buy in."

Topic Resource:

Joseph Gladke
Design-Build Program Director
Minnesota Department of Transportation
Office of Construction and Innovative Contracting, MS 687
395 John Ireland Blvd.
St. Paul, MN 55155
651-296-3283

A + B Contracting

Definition: A + B contracting is a method of bidding that includes both cost **and** time in making a low-bid determination for contract award purposes. In this formula, "A" = the dollar amount of the work to be performed and "B" = the number of calendar days bid to complete the work x the user-delay cost. The lowest "A + B" bidder is awarded the contract.

Number of Survey Responders: 2	**Depth of Experience:** More than 10 years (combined for all responders)
Benefits: • Reduced construction time **Applicability:** • Not applicable for projects with the potential for delays, i.e., utilities, complex projects, multi-year construction phasing, etc.	**Drawbacks:** • "Contractor must be knowledgeable of this type of bidding process."
Potential Obstacles: • Impacts to contractors are highly scrutinized. • Disagreements over compensable delays may be problematic.	**Lessons Learned:** "There must be a balance between the benefits of early completion and any increased cost of construction."

Topic Resource:

Mark Sehr
Rock County Engineer
P.O. Box 808
1120 N. Blue Mound Avenue
Luverne, MN 56156
507-283-5010

Contractor Milestones	
Definition: With this technique, contractors are financially awarded for meeting project milestones and for on-time delivery of specific work tasks.	
Number of Survey Responders: 2	**Depth of Experience:** More than 10 years (combined for all responders)
Benefits: • Reduced construction time **Applicability:** • Not applicable for project where you know there will be delays a contractor cannot control (public controversy, etc.).	**Drawbacks:** • Need for additional agency staff for administration/oversight.
Potential Obstacles: • Impacts to contractors are highly scrutinized. • Disagreements over compensable delays may be problematic.	**Lessons Learned:** "Clearly define the expectations that must be achieved to acquire the incentive."

Performance-Rated Specifications

Definition: The motivating idea behind using performance-rated specifications as part of the contracting process is that the critical need in any construction project is how it performs and that those specifications are ones the contractor must meet using whatever techniques are available to deliver the desired performance. In theory, this contracting method can lead to greater innovation and speed of delivery by putting some decisions for construction techniques into the hands of the experienced contractor.

Number of Survey Responders: 6	**Depth of Experience:** More than 10 years (combined for all responders)
Benefits: • Reduced construction time • Reduced project cost **Applicability:** • May not be applicable for small projects.	**Drawbacks:** • Need for additional agency staff for administration/oversight. • Increased project cost
Potential Obstacles: "The quality of the contractor's testing personnel or consultant can vary, but this can be addressed in the project specifications."	**Lessons Learned:** • "Be knowledgeable of the construction methods and materials that you are going to allow the contractor to test. Ensure that a quality working relationship is established with the contractor." • "We feel it gives the contractor a good planning tool for his work, while getting good quality control also. Makes the contractor take responsibility for his own product."

Topic Resource:

Tom Ravn
Minnesota Department of Transportation
395 John Ireland Boulevard, MS 650
St. Paul, MN 55155
651-296-6599

Value Engineering

Definition: Value engineering refers to the process of reviewing a project prior to letting in order to look for ways to improve quality, foster innovation, and lower costs. A VE study typically takes 4-5 days to perform and involves a multidisciplinary team. The VE job plan may include:

- Selecting the project for study;
- Investigating a project to find the problems;
- Brainstorming and developing alternatives to the existing design plan;
- Presenting recommendations to management;
- Approving and implementing the recommendations; and,
- Auditing the results.

Number of Survey Responders: 9

Depth of Experience: More than 10 years (combined for all responders)

Benefits:

- Reduced construction time
- Improved public relations
- Reduced project cost

Applicability:

- May be applicable for any type of project.

Drawbacks:

- Need for outside expertise.
- It takes time to review any proposals to be sure it is in our best interest and not just the interest of the contractor.
- Need for additional agency staff for administration/oversight.
- Increased project cost.

Potential Obstacles:

- It can be hard to keep it fair to the other bidders that bid a job the way you designed it and the contractor may have underbid a little knowing he has a good chance of changing the design to lower the cost.
- Our staff need to research the proposed technique.

Lessons Learned:

- "Keep an open mind. Make all contractors bid the way you have it designed or make an addendum if there is time to change the design. Consider proposals that save time and money and see if it is a value to you."

Topic Resources:

Jim Foldesi
St. Louis County Assistant County Engineer
100 5th Avenue West, #213
Duluth, MN 55802
218-625-3840

Michal Hanson
Mower County Engineer
1105 8th Avenue NE
Austin, MN 56007
507-437-7718

Utility Relocation Processes

<table>
<tr><th colspan="2">Utility Relocation</th></tr>
<tr><td colspan="2">Definition: Using this technique, greater responsibility is placed on the contractors to manage and conduct the utility relocation process and any other matters dealing with utlities.</td></tr>
<tr><td>Number of Survey Responders: 6</td><td>Depth of Experience: More than 10 years (combined for all responders)</td></tr>
<tr><td>Benefits:
Reduced construction time
Improved public relations
Reduced project cost
Applicability:
May be applicable for any type of project.</td><td>Drawbacks:
Increased project cost.</td></tr>
<tr><td>Potential Obstacles:
Utility reluctance</td><td>Lessons Learned:
“Just use it.”
“Work as a team (contractors/cities-counties) for the greatest efficiency.”</td></tr>
<tr><td colspan="2">Topic Resources:
Gary Bruggeman
Steele County Engineer
635 Florence Avenue
Owatonna, MN 55060
507-456-7472

Jim Grube
Hennepin County Engineer
1600 Prairie Drive
Medina, MN 55340
763-745-7507</td></tr>
</table>

Traffic Control/Construction Staging

Road Closure	
Definition: Occasionally total closure of a road may speed project construction. This technique utilizes that strategy.	
Number of Survey Responders: 15	**Depth of Experience:** More than 10 years (combined for all responders
Benefits: • Reduced construction time • Improved public relations • Reduced project cost **Applicability:** • Not applicable where a logical detour isn't available and if the closure will have unacceptable impacts to adjacent businesses. • Not applicable for a project where you can't close up the utility trench each evening.	**Drawbacks:** • Closing a lane may have an unacceptable impact on traffic. • Increased project cost • Specialized equipment needed
Potential Obstacles: • Keeping the public off the roadway. Even with barricades and signing, drivers would go through the ditches to try to get through. • Will need additional traffic control devices, flaggers and other measures to provide sufficient safety precautions. • People living adjacent to the project need to be accommodated with access. • Detour signs have to be monitored a lot to keep traffic going.	**Lessons Learned:** • "Involve law enforcement personnel for enforcement. Be prepared to turn in violators. Hire someone to sit at the end of the project to tell people they are not local traffic and cannot go through." • "Public must be adequately informed of all traffic closures, detours, or limitations." • "Safety is a major item." • "Analyze the traffic impact." • "Give it a try." • "Make sure affected parties are aware of implications." • "Use closure devices that are difficult to move."

Road Closure (cont.)

Topic Resources:

Denny Beyer
Swift County Assistant County Engineer
Highway Department Building
100 15th Street S.
Benson, MN 56215
320-842-5251

Don Theisen
Washington County Engineer
11660 Myeron Road N.
Stillwater, MN 55082
651-430-4304

Curt Bolles
Olmsted County
Government Center
151 4th Street SE
Rochester, MN 55904

Lane-Rental

Definition: This technique requires charging contractors time for lane closures during construction as an incentive to speed construction time.

Number of Survey Responders: 1	**Depth of Experience:** Two years
Benefits: • Reduced construction time **Applicability:** • Most appropriate for use when traffic closures/delays result in high user costs to the public.	**Drawbacks:** • Increased project cost.
Potential Obstacles: No Response	**Lessons Learned:** "Constant and continuous monitoring is required to document times and enforce specifications."

Topic Resource:

Tom Foley
City of Richfield
6700 Portland Avenue
Richfield, MN 55423
612-891-9792

APPENDIX A:

ABSTRACTS

TABLE A-1: SUMMARY OF ABSTRACTS

Category	Title
Equipment Innovations	High Accuracy Pavement Thickness Measurement Using Ground Penetrating Radar (Nondestructive Testing for Quality Control of New Pavement).
	Ground-Penetrating Radar for Cold In-Place Recycled Road Systems.
Materials Usage	Field Performance Evaluation of Class C Fly Ash in Full-Depth Reclamation: Case History Study.
	Identification and Stabilization Methods for Problematic Silt Soils: A Laboratory Evaluation of Modification and Stabilization Additives.
	Construction and Performance of Fly Ash-Stabilized Cold In-Place Recycled Asphalt Pavement in Wisconsin.
Construction Processes	Design-Build: A Holistic Approach.
	Turnkey Design-Build Best Value Procurement: The Branch Avenue Storage Yard.
	Concrete Bridges Provide Permanent Farm Access.
Human Resource Innovations	How Effective is Your Incentive Compensation System?
Contractor/Contracting Processes	Agencies and Contractors- Working Together.
	Value Engineering and Its Rewards
	A + B Contracting
	A+B Bidding Method--Hidden Success Story for Highway Construction.
	Getting the Job Done: Contractor Incentives Save Motorists Time, Money, Headaches.
	Comparison of Contracting Strategies for Reducing Project Construction Time. Final Report.
	NCHRP Guidelines Detail Innovative Contracting Methods.
	Performance Related Specifications: An Industry Perspective (with discussion).
	Strategies Used by State DOT'S to Accelerate Highway Construction Projects. In: Compendium: Papers on Advanced Surface Transportation Systems, 2002.
	Method to Model Performance Relationships and Pay Schedules.
	Proceedings of the Workshop on International Transit Turnkey and Joint Development. Session 4: Value Engineering, Design and Construction.

Category	Title
Contractor/Contracting Processes	Incentive/Disincentive Contracts: Perceptions of Owners and Contractors.
	Implementation of New Ride Quality Specification in Maryland: Incentive-Based Profile Specification.
	Performance-Based Contracting for the Highway Construction Industry: An Evaluation of the Use of Innovative Contracting and Performance Specification in Highway Construction.
Project Management Techniques	Resource-Activity Critical-Path Method for Construction Planning.
	Project Scheduling: Methods and Phases Involved in Planning a Schedule.
	Window Analyses of Compensable Delays.
Advanced Technology Applications	Improved Design Review Through **Web Collaboration**.
	Web-Based Information Management System for **Construction** Projects.
	Web-Based Rural Road Asset-**Management** System.
	Systems Integration: An Effective **Project Management** Tool for a Design-Build-Operate-Maintain Rail Project.
	States Turn on to **Web** for Highway **Bidding**.
	Emphasizing Design/Build.
	A New Paradigm in Communication: The **Web**-Enabled **Construction** Team.
	Web-Based Information Management System for **Construction** Projects.
	Selection and Implementation of **Web**-Based **Project Management** and Technical **Collaboration** Systems for Port Development Use.
	Streamline and Save $$.
	Improving the Delivery of Roadworks through **Online** Remote **Construction** Management
	AEC Internet **Project Management** Tools: The Good, the Bad, and the Future.
	Construction Baseline Productivity: Theory and Practice.
	A New Spin on **Bid** Sets.
Traffic Control/Construction Staging	Robert Frost Meets Woody Allen in the Work Zone.
	Lane Rental--Innovative Way to Reduce Road Construction Time.
	Strategies Used by State DOT'S to Accelerate Highway Construction Projects. In: Compendium: Papers on Advanced Surface Transportation Systems, 2002.

EQUIPMENT INNOVATIONS

HIGH ACCURACY PAVEMENT THICKNESS MEASUREMENT USING GROUND PENETRATING RADAR (NONDESTRUCTIVE TESTING FOR QUALITY CONTROL OF NEW PAVEMENT).

Ground Penetrating Radar (GPR) interpretation technology developed through the Strategic Highway Research Program (SHRP) was used to nondestructively determine pavement thickness on new pavements. The new pavements were **bid** per square yard (SY) of pavement surface area as either portland cement concrete pavement (PCCP) or full depth asphaltic concrete (AC). Since **bid** per SY, the pavements must meet Missouri specifications requiring the pavement to be no more than 0.2 in. thin of the plan depth. Missouri Department of Transportation (MoDOT) contracted with Pavement Systems Engineering and INFRASENSE Inc. to obtain and compare GPR data on the pavement thickness with the cores commonly taken for quality control and assurance by MoDOT. It was believed that GPR with good interpretation **software** and employing some special techniques could be capable of measuring to the 0.2 in. tolerance needed and in the future replace current coring practices (destructive testing) with GPR testing (nondestructive).

AU: Wenzlick-J; Scullion-T; Maser-KR
CA: Missouri Department of Transportation, P.O. Box 270, 105 West Capitol Avenue, Jefferson City, MO, 65102, USA; Federal Highway Administration, 400 7th Street, SW, Washington, DC, 20590, USA
SO: 1999/02. pp102
PY: 1999
RN: Report Number: RDT 99-003,; Report Number: RI96-11,; Report Number: Final Report

GROUND-PENETRATING RADAR FOR **COLD IN-PLACE RECYCLE**D ROAD SYSTEMS.

Due to a number of positive economic factors in the Saskatchewan economy, commercial truck traffic on many roads there has greatly increased in recent years. As a result, the Saskatchewan Dept. of Highways and Transportation (SDHT) is examining **cold in-place recycling** as a rehabilitation alternative for strengthening thin-paved roads. However, different **construction** practices and years of maintenance and rehabilitation have led to many of these thin-paved roads having a variable structural composition. The effect of in situ variability on **cold in-place recycle** designs is further exacerbated by the inherent sensitivity of stabilizers and/or concentrated chemicals when integrated into different road materials. As a result, the materials and structural design of **cold in-place recycle**d thin-paved road systems can be highly uncertain. Ground-penetrating radar (GPR) has been identified as a diagnostic tool that can accurately quantify in situ structural composition and help reduce the uncertainty associated with the material/structural design of **cold in-place recycle**d roads. This paper summarizes the principles of GPR, discusses the use of GPR as an engineering diagnostic tool for **cold in-place recycling** of thin-paved roads, and presents two pilot case studies conducted by the SDHT that demonstrate the capability of GPR to mitigate the uncertainty associated with **cold in-place recycle**d road systems.

AU: Berthelot-C; Scullion-T; Gerbrandt-R; Safronetz-L
SO: Journal of Transportation Engineering. 2001/07. 127(4) pp269-274 (8 Phot., 6 Fig., 1 Tab., Refs.)
PB: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400, USA
PY: 2001

MATERIALS USAGE

FIELD PERFORMANCE EVALUATION OF CLASS C **FLY ASH** IN **FULL-DEPTH RECLAMATION**: CASE HISTORY STUDY.

Class C **fly ash** is a coal combustion product from lignite or subbituminous coal obtained as a result of the power generation process. In recent years, efforts were taken to incorporate self-**cement**ing **fly ash** into **full-depth** reclaimed (FDR) material to improve the structural capacity of asphalt pavement base layers. In this study, existing asphalt pavement in County Trunk Highway (CTH) JK in Waukesha County, Wisconsin, was pulverized **in place** and mixed with **fly ash** and water to function as a base course. To evaluate the contribution of **fly ash** to the structural performance of the pavement, nondestructive deflection tests were performed with a KUAB 2m falling weight deflectometer on the outer wheelpath four days and one year after **construction**. The modulus of **fly ash**-stabilized FDR base course increased by 49 percent, one year after **construction**. The structural capacity of the **fly ash**-stabilized FDR base course in CTH JK also has increased significantly as it ages, because of the pozzolanic reaction. The results of this study indicate that the FDR mixes with self-**cement**ing **fly ash** may provide an economical method of **recycling** flexible pavements and reduce the need for expensive new granular base courses for road re**construction**.

AU: Wen-H; Tharaniyil-MP; Ramme-B; Krebs-S
SO: Transportation Research Record. 2004. (1869) pp41-46 (2 Phot., 2 Fig., 4 Tab., 16 Ref.)
NT: This paper appears in Transportation Research Record No. 1869, Pavement Rehabilitation, Strength and Deformation Characteristics, and Surface Properties 2004.
PB: Transportation Research Board, 500 Fifth Street, NW, Washington, DC, 20001-, USA
PY: 2004
RN: 0309094631

IDENTIFICATION AND STABILIZATION METHODS FOR PROBLEMATIC SILT SOILS: A LABORATORY EVALUATION OF MODIFICATION AND STABILIZATION ADDITIVES.

The instability and pumping response of non-plastic, high silt (and fine sand) soils was investigated. Common re**agent**s, i.e., **lime**, **lime-fly ash**, portland **cement**, and slag **cement** were included as admixtures with three high silt (and fine sand) soils. A series of laboratory tests simulated the moisture and loading conditions for 1) subgrade **construction** operations and 2) longer term, in service support of the completed pavement. Comparisons were based on the performance of mixtures with equal material costs. The improvements were found to vary with the re**agent**'s character, the mix proportion, and the role required, i.e., **construction** aid (modification) or in service performance (stabilization). The re**agent**s act as a **drying agent** during **construction** but, for the percentages used, produced only a small reduction in the original moisture content of the natural soil and only small increases in the plastic or cohesive character. For initial moisture contents up to +4 percent wet of optimum, smaller levels of re**agent**s were sufficient to retard or eliminate deformation under low cyclic loads, but extremely wet soils (4 to 8 percent of optimum) required larger volumes of re**agent**s. For long term

stability and greater increases in strength, the **cement**s followed by the **lime**-fly-ash produced the best results. Stabilization mixtures with re**agent**s producing **cement**itious products (portland **cement**) reduced the sensitivity of the soil to moisture changes.

AU: McManis-K
CA: University of New Orleans, Department of Civil and Environmental Engineering, New Orleans, LA, 70122-, USA; Louisiana Transportation Research Center, 4101 Gourrier Avenue, Baton Rouge, LA, 70808-4443, USA; Federal Highway Administration, 400 7th Street, SW, Washington, DC, 20590, USA
SO: 2003/07. 9904-0212 pp74
PY: 2003
RN: Report Number: FHWA/LA.02/371,; Report Number: Final Report; Contract/Grant Number: State Project No. 736-99-0691; Contract/Grant Number: LTRC Project No. 99-4GT

CONSTRUCTION AND PERFORMANCE OF **FLY ASH**-STABILIZED **COLD IN-PLACE RECYCLE**D ASPHALT PAVEMENT IN WISCONSIN.

Cold in-place recycling (CIR) is a common rehabilitation practice used in Wisconsin to improve the ride quality and structural capacity of deteriorated asphalt pavements. In recent years, increased emphasis has been placed on incorporating stabilizers into the CIR materials to improve the structural capacity of the CIR base layer. This improvement can serve to increase the performance life of the completed pavement or to allow for a reduced hot-mix asphalt (HMA) surface thickness. The city of Mequon, Wisconsin, included asphalt emulsion and **fly ash** CIR stabilization over a portion of its CIR projects in 1997. Presented are the findings relating to the constructability of the **fly ash**-stabilized CIR pavement as well as performance trends for the CIR pavements based on distress and deflection testing results. CIR is a common rehabilitation practice used in Wisconsin to improve the ride quality and structural capacity of deteriorated asphalt pavements. In one type of CIR application, existing HMA layers are pulverized, graded, and compacted, then used as a base layer for a new HMA surface. The pulverization process is completed to provide uniformity of support to the HMA surface and to significantly reduce or eliminate the occurrence of reflection cracking of the HMA surface. In most CIR applications, pulverization is completed through the full thickness of the existing HMA layers, as well as through the top 25 to 50 mm of aggregate base. Penetration into unbound aggregate base materials aids in cooling of the bits on the pulverizer mandrel. After pulverization, graders typically are used to spread the materials to the desired width and shape. Compaction is achieved by using vibrating steel drum and pneumatic-tire rollers. The moisture content of the CIR materials is adjusted, as necessary, by surface spraying from a water tanker truck.

AU: Crovetti-JA
SO: Transportation Research Record. 2000. (1730) pp161-166
NT: This paper appears in Transportation Research Record No. 1730, Issues in Pavement Design and Rehabilitation.
PB: Transportation Research Board, 2101 Constitution Avenue, NW, Washington, DC, 20418, USA
PY: 2000
RN: 0309067324

Construction Processes
DESIGN BUILD : A HOLISTIC APPROACH.

With parking structures' growing prominence in their related projects, **design-build**, versus design-bid-build using the lowest bidder, is gaining popularity. It gives a single source for accountability and increases efficiency by incorporating many elements into the project while it is still at the "paper" stage, when changes cost less to make. Pre-cast structural elements are preferred because of the tight quality controls possible in a manufacturing setting. Also, it is easier to anticipate future needs such as expansion in **design-build** approaches.

AU: Izenson-K
SO: Parking Today. 2002/04. 7(4) pp38-41
PB: Bricepac, Inc., 12228 Venice Boulevard, Suite 541, Los Angeles, CA, 90066-, USA
PY: 2002

TURNKEY DESIGN-BUILD BEST VALUE PROCUREMENT: THE BRANCH AVENUE STORAGE YARD.

Publicly funded **construction** project owners have continuously attempted to manage **construction** programs to achieve the best value for expanded public funds, while completing a project as expeditiously as feasible to provide the best possible service to the public. This paper looks at WMATA's (Washington Metropolitan Area Transit Authority) new approach, "Three-step Combination Approach: **Turnkey**, **Design-Build**, Best Value Procurement", to achieve this end.

AU: Ghosh-SK
CA: American Public Transit Association, 1201 New York Avenue, NW, Washington, DC, 20005-6141, USA
SO: Conference Title: 1999 Commuter Rail/Rapid Transit Conference, Proceedings. Location: Toronto, Canada. Sponsored by: American Public Transit Association. Held: 19990522-19990527. 1999. pp139-142
PY: 1999

CONCRETE BRIDGES PROVIDE PERMANENT FARM ACCESS.

This article describes Firth Stresscrete's new inexpensive and versatile **bridging** system, using a modified double tee flooring unit. These bridges have the following features: (1) they are designed to Works Corps Highway Bridge Design Brief specification; (2) they are designed to meet a variety of specific loadings; (3) they require no maintenance; (4) units are relocatable and thus resaleable; (5) units can be adapted to skewed angles, shorter spans and various handrail or wheel stop attachments; (6) there is minimal interruption to normal work during their rapid installation; (7) bridges are fully guaranteed and are completed with a registered engineer's design certificate; (8) pre-cast abutments can provide substantial savings at remote locations. Several district councils in New Zealand have benefited from this new form of **bridging**. For example, Firth Stresscrete has supplied Piako County Council with three bridges, which have been found to be cost-effective, have long-term advantages, and cause minimal delays during their placement.

SO: NEW ZEALAND CONCRETE **CONSTRUCTION**. 1990/05. 34 pp48-9
PB: CEMENT AND CONCRETE ASSOCIATION OF NEW ZEALAND, PRIVATE BAG, PORIRUA, UNITED KINGDOM
PY: 1990

Human Resource Innovations

HOW EFFECTIVE IS YOUR INCENTIVE COMPENSATION SYSTEM?

Recent surveys of the consulting engineering industry have found that more than 75 percent of U.S. engineering services firms provides some form of incentive compensation. Incentive compensation is a proactive, defined program in which staff members know up front what the objectives are and what the rewards will be. Bonus programs, by contrast, do not have clearly defined objectives, and rewards are typically discretionary. Bonus programs are characteristically reactive and after the fact. Research shows that monetary reward ranks a solid fifth in importance to people's job satisfaction. Four other factors that are more likely to cause job discontent are company policy and administration, supervision, relationship with supervisor, and work conditions. Research also shows that the top motivators are achievement, recognition, the work itself, and responsibility. A study of almost 1,500 workers across all skill sectors revealed some intriguing insights. Fully 80 percent of those who were on individual incentive pay systems would rather have been on a different system. The study also showed that the most highly committed and best-performing workers are rewarded predominantly through merit pay or individual incentives that recognize individual achievement. A sidebar highlights four past articles published in this journal that offer more information on compensation.

Index Terms:

Personnel management, Personnel retention, Personnel motivation, Salaries, Incentives, Disincentives, Job satisfaction, Personnel performance, Pay, Wages, Engineers, Consultants

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American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191-4400
USA

Contractor/Contracting Processes

AGENCIES AND CONTRACTORS- WORKING TOGETHER.

As an alternative to the traditional low-bid method for choosing a contractor, state DOTs and transportation researchers are looking at ways that build in more cooperation and collaboration to speed the procurement and construction process and minimize delays and disputes over changes in designs and costs. Design-build is one method gaining in popularity. It uses a lump-sum bid and eliminates middlemen consultants between the agency and the contractor. It also joins the contractor to the designer. However, political and legal restraints to ensure against collusion and conflicts of interest need to be addressed in many cases. Other processes being tried out include A + B bidding, which rewards contractors for cutting down on projects' completion times; pre-qualification of contractors and consultants to speed acceptance of bids; and performance specification, which sets objectives and leaves their achievement to the contractor.

AU: Stidger-RW
SO: Better Roads. 2002/03. 72(3) pp52-55
PB: James Informational Media, Incorporated, 2720 South River Road, Suite 126, Des Plaines, IL, 60018-, USA
PY: 2002

VALUE ENGINEERING AND ITS REWARDS

The **value engineering** clause in most construction contracts is often ignored because it involves design change in a short time. However, **value engineering** is necessary because of the complex and often adversarial relationship between the designer and the contractor. In this paper, the author, a design manager and geotechnical engineer, recounts her experiences in seeking to revise plans on projects before the start of construction. The projects involved were a design/build rail project, a design/build bus depot project, a design/bid/build project involving the reconstruction of a 100-year-old bridge, and a design/bid/build project to widen the Long Island Expressway. In all these projects, the author encountered initial resistance to her redesign recommendations, but ultimately derived satisfaction from having her **value engineering** solutions accepted.

AU: Bedian-MP
SO: Leadership and Management in Engineering. 2002/04. 2(2) pp36-37
PB: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400, USA
PY: 2002

A + B CONTRACTING

The new connector between westbound 80 and eastbound 580 in northern California's East Bay used a new method of contracting and a close working relationship between the California Department of Transportation (Caltrans) and the contractor. The method is known as **A+B** contracting, where contractors bid not just on price but the number of working days required. Each day of work was the equivalent of $20,000 in imposed user costs due to the delay during construction. The time for the project was one-third of Caltrans' estimate. Additional coordination with a nearby project enabled work to go on for two shifts a day, seven days a week, which also saved time and money.

AU: Jones-L; Vargas-R
SO: California Department of Transportation Journal. 2002/01. 2(4) pp22-25
NT: January-February 2002
PB: California Department of Transportation, 1120 N Street, Room 1200, Mail Stop 49, Sacramento, CA, 95814, USA
PY: 2002

A+B BIDDING METHOD--HIDDEN SUCCESS STORY FOR HIGHWAY CONSTRUCTION.

In the last 10 years, state departments of transportation across the nation have experimented with the **A+B** bidding method. Simply stated, contractors bid on the cost (part A) and on the time (part B), and the lowest combined bidder (**A+B**) is awarded the work. This paper analyzes 101 projects awarded by the **A+B** method and then compares the results to the cost and the time of similar projects awarded by conventional means (cost only). Results indicate that substantial savings in construction time are achieved when using the **A+B** method, with nearly equal costs. This is achieved by better planning and management of motivated contractors using the time element as part of their bidding strategy. Case studies are included to demonstrate the results.

AU: Herbsman-ZJ
SO: Journal of Construction Engineering and Management. 1995/12. 121(4) pp430-437
PB: American Society of Civil Engineers, 345 East 47th Street, New York, NY, 10017-2398, USA
PY: 1995

GETTING THE JOB DONE: CONTRACTOR INCENTIVES SAVE MOTORISTS TIME, MONEY, HEADACHES.

The Texas Transportation Institute initiated research into the advantages and disadvantages of contractor incentives. The goal of the research was to determine contracting strategies that would result in the least total cost to motorists during construction. This article describes several types of contract strategies, including: low-bid contract, Critical Path Method schedule, **A+B** bidding, and others. Researchers recommend that the use of incentives/disincentives be reserved for specific situations that meet certain criteria.

AU: McFarland-F
SO: TEXAS TRANSPORTATION RESEARCHER. 1994. Summer 30(2) pp6-7
PB: Texas Transportation Institute, Texas A&M University, College Station, TX, 77843-3135, USA
PY: 1994

COMPARISON OF CONTRACTING STRATEGIES FOR REDUCING PROJECT CONSTRUCTION TIME. FINAL REPORT.

The objectives of this study were: to develop criteria for evaluating alternative contracting strategies and make comparisons of the advantages and disadvantages of these strategies for different types of projects and situations; to evaluate ongoing and completed projects that use alternative bidding strategies and high liquidated damages based partially on user costs, and other alternatives for reducing project completion times; to evaluate techniques for estimating user costs during construction for different types of projects and situations. The HEEM-III and QUEWZ computer programs were used to estimate motorist costs for use in liquidated damages and for costs of lane closure. These programs were used to estimate user costs for a variety of added-capacity construction projects. Since funds are limited for construction projects, it is recommended that only 25 percent of calculated user costs be used in liquidated damages. Case studies emphasized Texas incentive/disincentive projects and other large, urban projects with emphasis on **A+B** bidding and use of a special CPM provision where contractors are not paid progress payments unless they meet contract provisions. In **A+B** bidding, contractors bid not only construction cost but also contract completion time, and both are considered in awarding the contract. At this time, it is recommended that incentive/disincentive provisions, with or without **A+B** bidding, should not be used routinely in Texas. They should be reserved for special cases of great urgency, of relatively short duration, with a clean set of plans, and with little chance of field changes. For all projects, but especially for large projects with heavy traffic in urban areas, liquidated damages should include user costs; so should incentives/disincentives. It is recommended that CPM scheduling and monitoring be used on large, critical projects. It is also recommended that **A+B** bidding be tried on a limited basis as experimental projects, when stated conditions are met and when there is a need to reduce project completion time.

AU: McFarland-WF; Kabat-RJ; Krammes-RA
CA: Texas Transportation Institute, Texas A&M University, College Station, TX, 77843, USA; Texas Department of Transportation, Office of Research and Technology Transfer, PO Box 5051, Austin, TX, 78763, USA; Federal Highway Administration, 400 7th Street, SW, Washington, DC, 20590, USA
SO: 1994/03. 9109-9308 pp83
NT: Research study title: New Evaluations of Liquidated Damages, Motorist Liquidated Damages, and Percent Retainage.
PY: 1994
RN: Report Number: FHWA/TX-94/1310-1F; Report Number: Res Rept 1310-1F; Report Number: TTI: 0-1310; Contract/Grant Number: Study 0-1310

NCHRP GUIDELINES DETAIL INNOVATIVE CONTRACTING METHODS.

The National Cooperative Highway Research Program (NCHRP) commissioned researchers to explore innovative alternatives to traditional contracting methods and to produce comprehensive implementation guidelines for their use. The guidelines outline three innovative contracting methods: warranty, multiparameter, and best value contracting. Each method focuses on a different aspect of cost-effective contract management, but all are intended to fulfill the same goals. Warranty contracting includes an extended warranty that places responsibility for product performance on the contractor, generating a longer lasting product and lower overall maintenance costs. In multiparameter contracting, agencies determine contract winners based on the lowest combination of cost, time, and other parameters. Best value contracting focuses on such factors as technical excellence, management capability, past performance, and personnel qualifications.

AU: Anderson-S
SO: Texas Transportation Researcher. 2000. 36(2) pp7
PB: Texas Transportation Institute, Texas A&M University, College Station, TX, 77843-3135, USA
PY: 2000

PERFORMANCE RELATED SPECIFICATIONS: AN INDUSTRY PERSPECTIVE (WITH DISCUSSION).

Specifications are used to convey information concerning desired products from a buyer to a seller or potential seller, they are used as a basis for competitive bidding for the delivery of products, and they are used to measure compliance to contracts. There are four types of specifications generally recognized in the construction industry: (1) proprietary product, (2) method, (3) end-result; and (4) performance. The current general state of highway specifications is represented by end-result specifications. In the future, efforts will be made to mathematically tie the end-result quality characteristics for the product to its performance; these will be referred to as performance-related specifications.

AU: Newcomb-DE; Hughes-C (Discusser); Christensen-D (Discusser); Hugo-F (Discusser); Ruth-B (Discusser); Page-G (Discusser); Monismith-C (Discusser)
SO: Conference Title: Asphalt Paving Technology 2001. Location: Clearwater Beach, Florida. Sponsored by: Association of Asphalt Paving Technologists. Held: 20010319-20010321. Journal of the Association of Asphalt Paving Technologists. 2001. 70 pp821-836
NT: Additional discusser (only six discussers can be listed in the discusser field): Dukatz, E.
PB: Association of Asphalt Paving Technologists, 400 Selby Avenue, Suite I, St Paul, MN, 55102-, USA
PY: 2001

STRATEGIES USED BY STATE DOT'S TO ACCELERATE HIGHWAY CONSTRUCTION PROJECTS. IN: COMPENDIUM: PAPERS ON ADVANCED SURFACE TRANSPORTATION SYSTEMS, 2002.

Every day motorists are faced with driving through construction work zones throughout the state of Texas. Some construction projects due to their location and type of traffic control increase congestion and delays. There is a need to speed up construction on all types of projects using accelerated construction strategies. To determine the extent of accelerated construction strategies usage in the United States, the author conducted a literature review and a state department of transportation (DOT) survey. The results of the survey indicate that most states that responded are using accelerated construction strategies in some form or fashion, especially on large projects that impact the highway travel lanes. Based on the research, the following techniques were determined to be applicable to address the problem of accelerating construction time: calendar day definition for working day; **incentive** using contract administrative cost; **milestone**s with **incentive**/dis**incentive** (I/D); substantial completion I/D; lane rental dis**incentive**; A+B provision; variable lead time; and design-build. Each of the techniques was classified by level of acceleration; however, the most widely used and most liked by DOTs and **contractor**s as well, are the I/D techniques. They are win-win situations for both parties and they result in shorter construction times and monetary gain to **contractor**s. Several techniques were applied to example projects in the Atlanta District in order to test the guidelines developed from this report. The results indicate that, depending on the type of project, size and location, there is always going to be an available technique that can be utilized to accelerate it. Guidelines for various levels of acceleration were developed from this report and the results of these guidelines appear to be applicable to all projects depending on the level of acceleration desired and warranted by a particular project.

AU: Ibarra-C; Dudek-CL (Editor)
CA: Texas Transportation Institute, Texas A&M University, College Station, TX, 77843-3135, USA; Southwest Region University Transportation Center, Texas Transportation Institute, Texas A&M University, College Station, TX, 77843-3135, USA
SO: 2002/08. pp83-125
NT: This study was supported by a grant from the U.S. Department of Transportation, University Transportation Centers Program.
PY: 2002
RN: Report Number: SWUTC/02/473700-00003-4; Contract/Grant Number: DTRS99-G0006

METHOD TO MODEL PERFORMANCE RELATIONSHIPS AND PAY SCHEDULES.

Performance-related specifications require mathematical models to link construction quality to expected life and, ultimately, to value expressed in the form of pay schedules. Although ongoing research efforts continue to advance the state of the art, the type of data needed to develop accurate and precise models may not become available for several years. In the interim, present engineering and mathematical knowledge can be used to create rational and practical models that will perform effectively until better models are available. Several examples are presented to illustrate how both analytical data and survey data can be used to develop realistic performance

models and pay schedules useful for statistical construction specifications. The issue of the proper method that can be used to combine the effects of multiple deficiencies is also addressed.

AU: Weed-RM
SO: Transportation Research Record. 2000. (1712) pp117-124
NT: This paper appears in Transportation Research Record No. 1712, Construction 2000.
PB: Transportation Research Board, 2101 Constitution Avenue, NW, Washington, DC, 20418, USA
PY: 2000
RN: 0309066913

PROCEEDINGS OF THE WORKSHOP ON INTERNATIONAL TRANSIT TURNKEY AND JOINT DEVELOPMENT. SESSION 4: **VALUE ENGINEERING**, DESIGN AND CONSTRUCTION.

Session highlights are as follows: (1) **Value engineering** (VE), quality control (QC) and quality assurance (QA) are close cousins. VE can result in considerable cost savings with no loss in QC/QA. (2) VE is comprehensive and includes the design, construction and procurement of major transit investments. The savings resultant from VE are frequently many times the costs of the VE studies. (3) Turnkey contracting can be a form of VE. Requirements for VE studies in transit turnkey projects are subject questions concerning the necessity in the context of the prevailing incentives. (4) The considerable cost savings generated by VE are typically shared between the owner and the contractors. Contractors are generally not rewarded for VE savings they identify in their work. (5) The incentives for VE in the design phase of conventional and turnkey projects are not certain. There must be incentives for the designer to engage in VE. (6) VE in the context of turnkey is still evolving. Just as turnkey is many different approaches with no single established practice, VE will have to adjust to the requirements, opportunities, incentives and constraints resulting from turnkey approach and procurement.

AU: Fernandez-NI; Luglio-TJ Jr.; Goff-AP; Waesche-F-III; Turpin-F; Gonzales-S
SO: Conference Title: Workshop on International Transit Turnkey and Joint Development. Location: San Juan, Puerto Rico. Sponsored by: Transportation Research Board, National Research Council; Federal Transit Administration, U.S. Department of Transportation; and Puerto Rico Department of Transportation and Public Works. Held: 19961015-19961019. Transportation Research Circular. 1998/03. (483) pp39-42
PB: Transportation Research Board, 2101 Constitution Avenue, NW, Washington, DC, 20418, USA
PY: 1998

INCENTIVE/DIS**INCENTIVE** CONTRACTS: PERCEPTIONS OF OWNERS AND **CONTRACTOR**S.

Incentive/dis**incentive** (I/D) contracting has developed from basic cost- and profit-sharing arrangements between an owner and a **contractor**. To motivate the **contractor** to put in an extra effort to realize one or more project objectives of an accelerated, costly, and complex undertaking, the owner may offer an award to the **contractor**. The owner may also threaten the **contractor** with a penalty if the objectives are not met. This paper reviews the fundamental I/D arrangements in contracting literature. Then, results are reported of a survey conducted on a sample of Illinois Department of Transportation (IDOT) highway contracts that included I/D provisions. The survey investigates whether there exists an agreement or disagreement between IDOT's and the **contractor**s' perceptions of I/D contract provisions. The findings reveal how I/D contract **milestone**s are established, how they are executed, what kind of work practices the **contractor** uses to fulfill I/D targets and how the contracting parties perceive I/D contracts' effectiveness as opposed to non-I/D contracts. Certain issues pointed out by the respondents as problematic and in need of further refinement in I/D applications are also highlighted. The survey questionnaire is appended.

AU: Arditi-D; Yasamis-F
SO: Journal of Construction Engineering and Management. 1998/09. 124(5) pp361-373
PB: American Society of Civil Engineers, 345 East 47th Street, New York, NY, 10017-2398, USA
PY: 1998

IMPLEMENTATION OF NEW RIDE QUALITY SPECIFICATION IN MARYLAND: INCENTIVE-BASED PROFILE SPECIFICATION.

The Maryland State Highway Administration (MDSHA) has developed a new, performance-based construction specification for ride quality. The new specification was developed as a strategy to meet an objective in the MDSHA business plan that requires the percentage of smoother pavements to increase statewide over the next 5 years. The new specification allows the use of inertial profiler testing devices as well as California-style rolling-wheel profilographs and includes incentive- and disincentive-based pay adjustments for asphalt paving. The specification includes an innovative approach to establishing acceptable ride quality values that considers many of the factors that affect the ability to construct a smooth riding surface. In addition, the specification includes clear identification of pay adjustments that are calculated using a software application developed by MDSHA. The new specification is to be included in all projects advertised after July 1, 2001, and implementation involves efforts to train construction project personnel in the use of the specification. Future implementation efforts phase out the use of the California-style profilograph by 2004. The efforts completed to date to develop the new specification are described, and highlights of the new specification are provided.

AU: Stephanos-P; Withee-J; Andrews-J
SO: Transportation Research Record. 2003. (1860) pp159-167
NT: This paper appears in Transportation Research Record No. 1860, Pavement Assessment, Monitoring, and Evaluation 2003.
PB: Transportation Research Board, 500 Fifth Street, NW, Washington, DC, 20001-, USA
PY: 2003
RN: 0309085977

PERFORMANCE-BASED CONTRACTING FOR THE HIGHWAY CONSTRUCTION INDUSTRY: AN EVALUATION OF THE USE OF INNOVATIVE CONTRACTING AND **PERFORMANCE SPECIFICATION** IN HIGHWAY CONSTRUCTION.

This project synthesizes information on the shortcomings and limitations of traditional methods of highway construction and maintenance contracting, and identifies new and innovative alternatives. The findings are based on a literature review and a survey of officials of the state departments of transportation, representatives from the highway construction industry and experts in highway construction management. Various contractor methods for highway construction projects are discussed, including traditional design-bid-build as well as innovative methods. Specifications for highway construction, relationships between specifications and contracting methods, and current practices by state departments of transportation are presented. Case studies were used to illustrate the impacts of innovative contracting on project cost, time and quality. Findings suggest that any contracting approach that departs from the traditional design-bid-build approach results in construction time reductions, lower costs, and comparable or better quality. Short warranties are the most common form of innovative contract for highway construction projects. It was concluded that performance-based specifications are easier to implement with innovative contracting approaches in which the risks of ensuring a high quality product are shifted to the contractor. Recommendations to encourage the use of innovative contracting approaches are provided.

AU: Carpenter-B; Fekpe-E; Gopalakrishna-D
CA: Battelle Memorial Institute, 505 King Avenue, Columbus, OH, 43201, USA; Koch Industries, Incorporated, 655 15th Street, NW, Suite 445, Washington, DC, 20005-, USA
SO: 2003/02. pp49
PY: 2003
RN: Report Number: Final Report

PROJECT MANAGEMENT TECHNIQUES

RESOURCE-ACTIVITY CRITICAL-PATH METHOD FOR **CONSTRUCTION** PLANNING.

In this paper, a practical method is developed to address the fundamental matters and limitations of existing methods for critical-path method (CPM) based resource scheduling, which are identified by review of prior research in resource-constrained CPM scheduling and repetitive scheduling. The proposed method is called the resource-activity critical-path method (RACPM), in which: 1) the dimension of resource in addition to activity and time is highlighted in project scheduling to aid in coordination of activity planning and resource planning; 2) the start/finish times and the floats are defined as resource-activity attributes based on the resource-technology combined precedence relationships; and (3) the "resource critical" issue that has long baffled the **construction** industry is clarified. The RACPM is applied to an example problem taken from the literature for illustrating the algorithm and comparing it with the existing method. A sample application of the proposed RACPM for planning a footbridge **construction** project is also given to demonstrate that practitioners can readily interpret and utilize a RACPM schedule by relating the RACPM to the classic CPM. The RACPM provides schedulers with a convenient vehicle for seamlessly integrating the technology/process perspective with the resource use perspective in **construction** planning. The effect on the project duration and activity floats of varied resource availability can be studied through running RACPM on different scenarios of resources. This potentially leads to an integrated scheduling and cost estimating process that will produce realistic schedules, estimates, and control budgets for **construction**.

AU: Lu-M; Li-H
SO: Journal of **Construction** Engineering and Management. 2003/07. 129(4) pp412-420
PB: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400, USA
PY: 2003

PROJECT SCHEDULING: METHODS AND PHASES INVOLVED IN PLANNING A SCHEDULE.

Project schedules are important and highly useful tools for civil engineers. The preparation of schedules allows for detailed planning of work activities and provides a device for communicating critical dates and activities to clients, consultants, and the internal project team. In addition, schedules provide a tool to help program the project, test alternative approaches, and evaluate job performance. Many scheduling methods exist, and each has its own strengths and weaknesses. Several include full wall scheduling, bar charts, **critical path** method (CPM), and program evaluation and review technique (PERT). Networking a project involves dividing the job into units or work that is relevant to the people for whom the network is being prepared. There are three phases of networking: planning, scheduling, and monitoring. For many networking applications, simple personal computer-based software is available.

AU: Birnberg-H
SO: Civil Engineering News. 1999/03. 11(2) pp58-60
PB: Civil Engineering News, Incorporated, 1255 Roberts Boulevard, Suite 230, Kennesaw, GA, 30144-, USA
PY: 1999

WINDOW ANALYSES OF COMPENSABLE DELAYS.

The identification and analysis of compensable delays become necessary on most **construction** projects. Although there are several different analytical techniques available, the window method of contemporaneously analyzing delays is the most realistic. The reasons for the superiority of the window method are discussed. The possible results of a window analysis are evaluated and graphically presented. Also discussed is a correction, or intermediate step, in the method, necessary to avoid incorrect findings of false concurrency, and the proper method for handling apportionable and non-apportionable delays. Finally, an argument is made that the burden of proving non-compensable delays, assuming a proper window analysis of compensable delays by a contractor, should be borne by the owner.

AU: Finke-MR
SO: Journal of **Construction** Engineering and Management. 1999/03. 125(2) pp96-100
PB: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400, USA
PY: 1999

Advanced Technology Applications

IMPROVED DESIGN REVIEW THROUGH **WEB COLLABORATION**.

An in-depth analysis of the impact of **Web collaboration** has shown that it is a very effective medium for conducting design reviews and offers many benefits over traditional manual methods of comment collection and resolution. Findings from two federal agencies have shown a significant reduction in both time required to conduct a design review and number of required participating parties. An economic analysis of the impact of **Web collaboration** on the design review process done for U.S. Corps of Engineers projects shows that using the **Web** for design review **collaboration** provides a 73 percent savings in meeting time and travel cost.

AU: East-EW; Kirby-JG; Perez-G
SO: Journal of Management in Engineering. 2004/04. pp51- 55
PB: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400,

WEB-BASED INFORMATION MANAGEMENT SYSTEM FOR **CONSTRUCTION** PROJECTS.

Construction project managers must systematically organize a large volume of incoming information while responding to daily requests on project-related matters. This paper presents a **web**-based project information management system (**Web**PIM) that can be used in civil engineering applications, particularly in **construction project management**. All project information in the proposed system is centralized in a **project database** residing in the project server, instead of being distributed to many different locations. By utilizing the latest **web** technology, the system works as an information platform for all design and **construction** participants of a **construction** project throughout the project's life cycle. A prototype model is designed in this paper to illustrate the application of the proposed system and the hardware and **software** requirements for the intended application. Data transfer speed and security are addressed. The **Web**PIM system developed here can be used as a platform for expanding to other project functions such as project scheduling, material procurement and remote site investigation.

AU: Lam-HF; Chang-T-YP
SO: Computer-Aided Civil and Infrastructure Engineering. 2002/07. 17(4) pp280-293
PB: Blackwell Publishers, 350 Main Street, Malden, MA, 02148-, USA
PY: 2002

WEB-BASED RURAL ROAD ASSET-**MANAGEMENT** SYSTEM.

The Department of Accelerated Rural Development in Thailand has undergone major structural reforms according to the direction of National Economic and Social Development Plan 9, which decentralizes government authority into subdistrict levels. The goals for subdistrict level **management** are to improve the quality of life and the living standard through economic and social development in rural areas. By restructuring the maintenance practice and policy to complement the new orientation of the plan and to enable the proper planning of rural road asset

maintenance activities, a systematic rural road asset-**management** system was implemented to achieve the goal of the subdistrict and central **management**. A web-based technology was used to provide an easy linkage between the central and the **remote** offices for both network and **project**-level **management**. The organizational barriers, development process, tools and technology, data integration, and benefits of the improved data-**management** system are discussed. The developed system includes data regarding pavement, bridge, drainage system, traffic sign, pavement marking, and vegetation problems. How web-based information technology can be applied to an asset-**management** system is discussed. The benefits are measured for productivity, profitability, and rural road user effects.

AU: Herabat-P; Satirasetthavee-D; Amekudzi-A
SO: Transportation Research Record. 2003. (1855) pp105-111
NT: This paper appears in Transportation Research Record No. 1855, Transportation Data Research.
PB: Transportation Research Board, 500 Fifth Street, NW, Washington, DC, 20001-, USA
PY: 2003
RN: 0309085918

SYSTEMS INTEGRATION: AN EFFECTIVE **PROJECT MANAGEMENT** TOOL FOR A DESIGN-BUILD-OPERATE-MAINTAIN RAIL PROJECT.

The term "systems integration" is associated with computer **software** integration or computer **software**/hardware integration. However, systems integration applications in the automotive, aerospace and defense industries are equally common and more rigorously applied. Systems integration is now becoming mainstream in new start rail projects. Traditionally with design-**bid**-build projects, the owner, not the contractor, has carried out coordination and integration role between design teams. With the introduction of the design-build-operate-maintain (DBOM) contracting approach, the role is transferred to the Contractor, who must establish a rigorous systems integration process. Independently from the industry, systems integration is a continuing process, which operates through the design, **construction**, and installation, start up, activation phase of a product life cycle. System integration also continues to have a role during operation and maintenance activities. This paper presents a brief synopsis of how systems integration is being applied on the Southern New Jersey Light Rail Transit System rail project. Systems integration is defined along with the major tools required during the process and the challenges faced by systems integration are also presented.

AU: Kouassi-AJ
CA: Institute of Transportation Engineers, 1099 14th Street, NW, Washington, DC, 20005-3438, USA
SO: Conference Title: Improving Transportation Systems Safety and Performance. 2001 Spring Conference and Exhibit. Location: Monterey, California. Sponsored by: Institute of Transportation Engineers. Held: 20010325-20010328. 2001. pp8
NT: Full conference proceedings available on CD-ROM, ISBN 0935403604.
PY: 2001

STATES TURN ON TO **WEB** FOR HIGHWAY **BID**DING.

State departments of transportation (DOTs) are expanding their use of the Internet to accept and process contract **bid**s, though acceptance by contractors is far from universal. Some 34 DOTs are building systems with **software** licensed from the American Association of State Highway & Transportation Officials (AASHTO). Others are developing their own. Despite precautions such as encryption, electronic signature registries and electronic lockboxes, some contractors still have security concerns and find it difficult to trust their **bid**s to delivery via computer **software**.

AU: Sawyer-T
SO: ENR. 2001/02/26. 246(8) pp53-54
PB: McGraw-Hill Information Systems Company, 1221 Avenue of the Americas, New York, NY, 10020, USA
PY: 2001

EMPHASIZING DESIGN/BUILD.

Most states have traditional procurement processes for the acquisition of products and services. These are (1) low-**bid** with or without prequalification "letting," developed for use in the acquisition of **construction** projects; (2) professional engineering services/consultant selection, which is based on technical qualifications, and (3) "nonprofessional services" selection, which typically considers both qualifications and price. Each process has its own strengths, when procuring a single product or service. When procuring a technically sophisticated system, careful consideration of which procurement process(es) to use is necessary, in order to gain the appropriate balance of technical sophistication, system quality, and cost effectiveness. The combination product/service procurement that is necessary to design and deploy Intelligent Transportation Systems (ITS) infrastructure has characteristics that call for multiple types of procurement. The combination of field equipment, facility, control center equipment, and computer hardware/**software** into a single procurement has some demonstrated advantages, as is being found in several "experimental" procurements around the country. The purpose of this white paper is to present and discuss an alternative in procurement methodology for projects deploying ITS infrastructure. First, the paper will set the scene; then it will describe some of the pitfalls of the traditional methods. Lastly, it will discuss the applications of design/build in addressing or avoiding those problems.

AU: Pearce-VP
CA: Institute of Transportation Engineers, 525 School Street, SW, Suite 410, Washington, DC, 20024-2729, USA
SO: Conference Title: Institute of Transportation Engineers 67th Annual Meeting. Location: Boston, MA. Sponsored by: Institute of Transportation Engineers. Held: 19970803-19970807. 1997. n.
NT: Full conference proceedings available only on CD.
PY: 1997

A NEW PARADIGM IN COMMUNICATION: THE **WEB**-ENABLED **CONSTRUCTION** TEAM.

From member forums to project **web** sites, many believe that the Internet and its relatively simple working environment is the catalyst that will transition the **construction** industry from paper to digital communication, particularly in the way of project **collaboration** and **project management**. In terms of **online project management**, there is a tool on the market today to meet just about anyone's business requirements and technology skills. The infrastructure that supports each of these **online** services is similar. Most take advantage of advanced server technology to store and manage project information as it is submitted from project participants. The server is managed entirely by the provider in a secure, password-protected environment. Firms of all sizes in all capacities are buying into these services as a way to manage information better and faster and thereby build quality facilities. Fees for these **online** services vary, some charging per user, others per project. Some architecture/engineering/**construction** professionals opt to develop their own **web**-based **project management** sites. Many firms start out simple, building a **web** page that simply disseminates corporate information. Others use it to simply record project progress, something that visitors to the site can use to stay current. As the industry continues its rapid development process, experts predict that it will not be long before all facets of **construction software**-accounting, computer aided design, estimating, **project management**, and scheduling will have similar functionality to share information via the Internet.

SO: ENR. 1998/06/01. 240(22) pp2
NT: Included in a special advertising section, "Computers," to this journal issue. Page Range: pp C4, C7
PB: McGraw-Hill Information Systems Company, 1221 Avenue of the Americas, New York, NY, 10020, USA
PY: 1998

WEB-BASED INFORMATION MANAGEMENT SYSTEM FOR **CONSTRUCTION** PROJECTS.

Construction project managers must systematically organize a large volume of incoming information while responding to daily requests on project-related matters. This paper presents a **web**-based project information management system (**Web**PIM) that can be used in civil engineering applications, particularly in **construction project management**. All project information in the proposed system is centralized in a **project database** residing in the project server, instead of being distributed to many different locations. By utilizing the latest **web** technology, the system works as an information platform for all design and **construction** participants of a **construction** project throughout the project's life cycle. A prototype model is designed in this paper to illustrate the application of the proposed system and the hardware and **software** requirements for the intended application. Data transfer speed and security are addressed. The **Web**PIM system developed here can be used as a platform for expanding to other project functions such as project scheduling, material procurement and remote site investigation.

AU: Lam-HF; Chang-T-YP
SO: Computer-Aided Civil and Infrastructure Engineering. 2002/07. 17(4) pp280-293
PB: Blackwell Publishers, 350 Main Street, Malden, MA, 02148-, USA
PY: 2002

SELECTION AND IMPLEMENTATION OF **WEB**-BASED **PROJECT MANAGEMENT** AND TECHNICAL **COLLABORATION** SYSTEMS FOR PORT DEVELOPMENT USE.

The appropriate use of Internet-based **collaboration software** facilitates improved **project management** and technical **collaboration** efficiency. Port projects provide a perfect opportunity for the use of these systems because there tend to be many firms involved that are dispersed geographically. Project **web**sites and **collaboration** systems (PWs) enable teams to share time-critical information and documents and gain community. Challenges include 1) understanding PW options and selecting a solution; 2) how to use PWs without "losing" a team to frustration, lack of interest, or the reversion to older systems; and 3) how to evaluate the costs and benefits of alternatives. This paper highlights specific port projects where PWs have added value and facilitated communication in design, program, and **construction** management projects.

AU: Johnson-D
CA: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400, USA
SO: Conference Title: Port Development in the Changing World. Ports 2004. Location: Houston, Texas. Sponsored by: Ports and Harbors Technical Committee of the Coasts, Oceans, Ports and Rivers Institute (COPRI) of the American Society of Civil Engineers; Permanent International Association of navigation Congresses, US Section, (PIANC); Transportation Research Board. Held: 20040523-20040526. 2004. pp11
NT: Full conference proceedings available on CD-ROM.
PY: 2004
RN: 0784407274

STREAMLINE AND SAVE $$.

This article describes two new **software** tools that can improve budget and payment processes for contractors and owners. The first tool is the IntelliCost system, which handles **bid**ding, **bid** analysis, budget-to-actual comparison and change management. The IntelliCost system is being used by the Montgomery County Department of Public Works and Transportation in Maryland to monitor and analyze costs for its capital **construction** program. The second tool is a new application for payment solution developed by PrimeContract. The PrimeContract application streamlines the payment process by transitioning it from paper to an electronic commerce process. Features of the two systems are described and compared.

AU: Levin-P
SO: Constructor. 2002/08. 84(8) pp34, 36

PB: Associated General Contractors of America, 1957 E Street, NW, Washington, DC, 20006, USA
PY: 2002

IMPROVING THE DELIVERY OF ROADWORKS THROUGH **ONLINE** REMOTE **CONSTRUCTION** MANAGEMENT

This paper describes early trials in the Queensland Department of Main Roads of **online** remote **construction** management (ORCM), the aim of which is to use electronic communication technologies to enhance **online** real time communication between the parties to a **construction** project, and thus improve the roadworks delivery process. ORCM uses electronic communication processes (such as the Internet) to maximize the use of time of personnel engaged in **construction** projects and reduce the large amounts of paperwork generated in many **construction** projects. It has particular advantages where the parties in a project are geographically dispersed. Trials of this methodology by the Department are taking place in both rural and urban areas. This research is evaluating the issues and benefits associated with the implementation of this methodology. A typical trial site is described. This site has used a **web**-based system to manage communications between principal, superintendent, contractor and the site. At this early stage, the process is promising. Areas that require further consideration include the strengthening of the legal position with respect to the use of electronic transactions, and the security and integrity of data. The associated risks require management and the implementation of appropriate processes, such as putting in place appropriate precautions and developing suitable contract documentation. At the time of writing, the next stages of the research are trials of ORCM in pre-**construction** and maintenance, and enhancement into a total intelligent project delivery process through adding to the process other technologies such as video conferencing and wireless transmission, and incorporating into the process electronically aided design and **project management** technologies. (a) For the covering entry of this conference, please see ITRD E204173.

AU: THORPE-D (Queensland. Department of Main Roads)
SO: ARRB TRANSPORT RESEARCH LTD CONFERENCE, 20TH, 2001, MELBOURNE, VICTORIA, AUSTRALIA. 2001. 18P
PB: ARRB TRANSPORT RESEARCH LTD, 500 BURWOOD HIGHWAY, VERMONT SOUTH, VICTORIA, 3133, AUSTRALIA
PY: 2001
RN: 0-86910-799-2

AEC INTERNET **PROJECT MANAGEMENT** TOOLS: THE GOOD, THE BAD, AND THE FUTURE.

The paper discusses the activity in the area of Internet-based **project management** (PM) for the Architectural, Engineering, and **Construction** (AEC) industry. It identifies some of the benefits such as the recognizing by organizations the medium's potential to manage information, communicate and collaborate, as well as test the many tools and services being offered. It is also

necessary to recognize that many users are not ready for the latest **web**-based PM tools and techniques. The paper identifies what works and what does not work, and discusses the need for the industry to set common standards and interfaces to utilize the Internet and other emerging technologies to leverage the benefits and opportunities available.

AU: Sadik-Khan-J; Eberhard-D
CA: American Public Transportation Association, 1666 K Street, NW, Washington, DC, 20006-, USA
SO: Conference Title: Rail Transit Conference. Location: Boston, Massachusetts. Sponsored by: American Public Transportation Association. Held: 20010610-20010614. 2001. pp3
NT: Full conference proceedings available on CD-ROM.
PY: 2001

CONSTRUCTION BASELINE PRODUCTIVITY: THEORY AND PRACTICE.

In this paper, the theoretical basis for **construction** labor productivity measurement is presented. In particular, the theoretical basis for baseline productivity measurements is developed by examining a productivity database consisting of 23 projects involving masonry **construction**. An important hypothesis is presented showing that as the design becomes more complex, the baseline productivity worsens. It is also hypothesized that higher values of the coefficient of variation indicates a higher variability in management and craft skills and in the use of technology. Two measures are proposed to measure the performance of individual projects: the disruption index and the **project management** index. These two measures identify the best and worst performing projects. Cumulative probability distributions of the disruption index and the **project management** index were also developed to evaluate the 23-**project database** and compare it with other databases. The hypotheses developed from the 23-masonry **project database** were tested against an eight-**project database** of concrete formwork and a 12-**project database** of structural steel erection. Strong support for each hypothesis was found using the two additional databases.

AU: Thomas-HR; Zavrski-I
SO: Journal of **Construction** Engineering and Management. 1999/09. 125(5) pp295-303
PB: American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA, 20191-4400, USA
PY: 1999

A NEW SPIN ON **BID** SETS.

Electronic **bid**s sets (EBSs) can save time, money, errors, and headaches. By putting **construction** documents on CD and then using various **software** programs to view them, one can simplify the **bid** process and offer a greater number of participants access to the process. Learning to create and use them may take some effort, but the payoffs justify the investment. Electronic storage can save time as well as space. With **construction** documents in a more accessible, electronic format, searches go much faster, and there is far less chance of any data

getting misplaced. In addition, with **Web** server technology, an electronic search can be extended to look within documents that are stored on a server. EBSs are in their infancy, and many more improvements lie in the near future. A sidebar lists resources on EBS and creating CDs.

AU: Watson-MS
SO: Civil Engineering. 1998/08. 68(8) pp55-57 (2 Fig.)
PB: American Society of Civil Engineers, 345 East 47th Street, New York, NY, 10017-2398, USA
PY: 1998

TRAFFIC CONTROL / CONSTRUCTION STAGING

ROBERT FROST MEETS WOODY ALLEN IN THE WORK ZONE.

Lane rental, A+B bidding, incentives for early completion, and night construction have all reduced the impact of road construction on users. However, the best guidance on estimating user delay costs (UDCs) in the future is included in the Federal Highway Administration Interim Technical Guide on Life Cycle Cost Analysis. The procedure outlined in the guide provides a reasonable approach to estimating UDC so that different strategies may be compared. It has recently been suggested that the transportation industry should apply a salvage value to UDCs as they do with construction and rehabilitation costs. The argument is that the salvage value most commonly used for construction, maintenance, and rehabilitation costs is not truly a salvage value but a deferred cost. Users also pay a cost in time and vehicle operating costs that helps to defer the next time they will incur a cost. Therefore, a salvage value should be applied to UDCs. This article argues that by using salvage value for UDCs, the impact to users in the future may well be ignored. Potentially, it could result in constructing projects today that cannot be rehabilitated in the future without unreasonable impacts on the user.

AU: Hansen-K
SO: HMAT. 2000/09. 5(5) pp32-34
PB: National Asphalt Pavement Association, 5100 Forbes Boulevard, Lanham, MD, 20706-4413, USA
PY: 2000

LANE RENTAL--INNOVATIVE WAY TO REDUCE ROAD CONSTRUCTION TIME.

In recent years, the public has faced a substantial increase in the number of transportation projects that are being constructed in urban areas under heavy traffic. This type of construction is causing the public major inconvenience, is increasing the number of accidents, and is causing substantial losses to the business community in the affected areas. Because of a perception that contractors focus only on their obligations of meeting budget and schedule considerations under conventional contracting methods and that they do not consider the inconvenience to the public caused by construction work, new contracting methods have been developed that specifically address this problem. This paper describes a method that has been used in the United Kingdom called **lane rental**. The **lane rental** method combines the cost to the using public for the closing of urban traffic routes with the traditional costs of construction. Under this system, contractors are required to consider, and include, both of these costs in the bidding process. The principles of **lane rental** and the adaptation to the construction industry environment in the United States are discussed in this paper. Two case studies of projects that are bid under **lane rental** provisions and the lessons that can be learned from those cases are described in this paper.

DE: UNITED-KINGDOM; LANE-RENTAL; HIGHWAY-CONSTRUCTION; ROAD-CONSTRUCTION; CONSTRUCTION-SCHEDULING; CONTRACTING-; CONTRACT-ADMINISTRATION; URBAN-AREAS; CONSTRUCTION-COSTS; INCONVENIENCE-; HIGHWAY-USER-COSTS; ROAD-USER-COSTS; CONTRACTORS-; CONTRACTORS-BIDS; CONSTRUCTION-INDUSTRY; UNITED-STATES; CASE-STUDIES; CONSTRUCTION-PROJECTS
SC: CONSTRUCTION (H33); ADMINISTRATION (H11); CONSTRUCTION-OF-PAVEMENTS-AND-SURFACINGS (I52); ECONOMICS-AND-ADMINISTRATION (I10)
PA: American Society of Civil Engineers
AU: Herbsman-ZJ; Glagola-CR
SO: Journal of Construction Engineering and Management. 1998/09. 124(5) pp411-417
PB: American Society of Civil Engineers, 345 East 47th Street, New York, NY, 10017-2398, USA
PY: 1998

STRATEGIES USED BY STATE DOT'S TO ACCELERATE HIGHWAY CONSTRUCTION PROJECTS. IN: COMPENDIUM: PAPERS ON ADVANCED SURFACE TRANSPORTATION SYSTEMS, 2002.

Every day motorists are faced with driving through construction work zones throughout the state of Texas. Some construction projects due to their location and type of traffic control increase congestion and delays. There is a need to speed up construction on all types of projects using accelerated construction strategies. To determine the extent of accelerated construction strategies usage in the United States, the author conducted a literature review and a state department of transportation (DOT) survey. The results of the survey indicate that most states that responded are using accelerated construction strategies in some form or fashion, especially on large projects that impact the highway travel lanes. Based on the research, the following techniques were determined to be applicable to address the problem of accelerating construction time: calendar day definition for working day; incentive using contract administrative cost; milestones with incentive/disincentive (I/D); substantial completion I/D; **lane rental** disincentive; A+B provision; variable lead time; and design-build. Each of the techniques was classified by level of acceleration; however, the most widely used and most liked by DOTs and contractors as well, are the I/D techniques. They are win-win situations for both parties and they result in shorter construction times and monetary gain to contractors. Several techniques were applied to example projects in the Atlanta District in order to test the guidelines developed from this report. The results indicate that, depending on the type of project, size and location, there is always going to be an available technique that can be utilized to accelerate it. Guidelines for various levels of acceleration were developed from this report and the results of these guidelines appear to be applicable to all projects depending on the level of acceleration desired and warranted by a particular project.

AU: Ibarra-C; Dudek-CL (Editor)
CA: Texas Transportation Institute, Texas A&M University, College Station, TX, 77843-3135, USA; Southwest Region University Transportation Center, Texas Transportation Institute, Texas A&M University, College Station, TX, 77843-3135, USA
SO: 2002/08. pp83-125
NT: This study was supported by a grant from the U.S. Department of Transportation, University Transportation Centers Program.
PY: 2002
RN: Report Number: SWUTC/02/473700-00003-4; Contract/Grant Number: DTRS99-G0006