SD96-06-F

SD Department of Transportation
Office of Research

Improvement of the Materials Certification Process

Study SD96-06
Final Report

Prepared by
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January 1998

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16. Abstract

An investigation of the materials certification process of the South Dakota Department of Transportation was conducted. The purpose of the investigation was to evaluate how the certification process worked, and identify areas where improvements could be made. A key part of the investigation was to determine both the Department's process, as written, and the field practice by reviewing relevant manuals and specifications, and interviewing department staff, contractors, and suppliers. Discrepancies and redundancies that existed were identified, including the reasons for the discrepancies and redundancies. In addition, a survey was sent to all of the other State Departments of Transportation to determine how they use certificates. The investigation found several that the Department's field practice did not always match the procedures as described in their Materials Manual. Modifications to both the field practices and written processes were recommended to eliminate the discrepancies and redundancies that currently exist. Some of the recommendations included the use of umbrella certifications of systems that, at present, require a large number of certificates and visual documentation. Such systems include guard rails, lighting systems, signal systems, chain link fences, buildings, and pavement marking and signing materials.

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Executive Summary

1.1 Purpose of Study

Certifications of the materials used in highway construction are an important part of the engineering, legal and regulatory requirements of the process of building and maintaining a highway system. However, the current certification processes as practiced require a significant amount of time by suppliers, contractors and South Dakota Department of Transportation (Department) staff. A lack of understanding of the processes and a lack of consistent follow-through on certifications has created dissatisfaction among all the parties who are involved and a desire to improve the processes. Staff reductions have also created a need to reduce the effort required. This study is to evaluate those certification processes for their necessity, suitability and to recommend ways to improve them.

Certifications indicate the materials and products used in construction are what was specified by the designer. They protect the highway user, State, engineer, and contractor from the problems which would arise out of poor materials. Certifications are part of the process that requires all bidders to bid on the same thing. Certifications also reduce the amount of testing required.

The purposes of this study are to:

- evaluate the needs of the users, materials industries, contractors, and the Department and the problems they are experiencing with the existing processes,
- evaluate the processes used by the Department, other states and private enterprise, and
- recommend ways to improve the Department's processes to be more cost-effective while meeting the engineering and legal requirements.

1.2 General Approach

The study began with a search for information about the processes and problems as experienced by the highway industry in South Dakota and generally across the United States. Sources included a literature search, interviews with contractors and suppliers active in building roads in South Dakota, interviews with various staff of the Department, a survey of other state Departments of Transportation, and our own experience with certifications in private construction.

With the knowledge from the new information, we have formulated opinions on the magnitude and cause of the problems in South Dakota and proposed revisions to the certifications processes. We have

documented the reasons for our opinions and recommendations in the complete report. We have recommended activities to implement the new recommendations.

1.3 Significant Findings

- Very few "failures" of the South Dakota certification system were identified in our contractors, suppliers and Department staff interviews. A failure of the certification system is defined as the use of a material that did not meet specifications which caused the material to not meet its intended roadway use.

- A 1982 study[1] disclosed many of the same problems expressed by the technical panel and Department staff.

- Published studies[1] and personal experiences document that a certification process that has no verification is not effective in preventing intentional or unintentional use of poor materials.

- All state transportation agencies rely on Certifications or Approved Products Lists.

- A majority of agencies conduct some sort of verification testing.

- Sixty-eight percent of the agencies that responded to the survey question on improvements indicate that they have made improvements in the certification process.

- Fifty-seven percent of the survey respondents indicate they use some sort of package certification.

- Twenty agencies indicated they accept umbrella certifications while 15 agencies indicated they do not.

- Five out of 33 that responded to the survey question stated that they use warranties in lieu of certifications.

- Suppliers, contractors and Department staff do not have a clear idea of the processes currently required by the Department.

- Suppliers, contractors and Department staff do not have a good picture of the value of certifications to all the parties in the construction process.

- The actual certification practices do not follow the written processes in many cases.

- Many staff and contractors indicated the processes have improved in the last two years.

- Contractors install materials and receive payment for materials placed even if no certificate is available.

- Field staff do not feel empowered to enforce the certificate requirements as prescribed by the Materials Manual.

- The staff time required to handle certifications is minimal if the process is followed, but becomes significant if the process is not followed. Staff estimates suggest a one-half hour activity done at the right time requires several hours at the end of the project.

- Secondary issues that are strongly related to certifications include the RECORD OF VISUAL INSPECTION AND FIELD MEASUREMENTS, (DOT-25) forms and the Approved Products List.

- The Federal Highway Administration (FHWA) Technical Advisory T 5080.11 states "The purpose of a materials acceptance plan is to assure, with reasonable risks, the material meets the specifications."

- The regulatory issues of the FHWA are described in 23 CFR. 23 CFR states that the agency must have an established and FHWA approved operating procedure that adequately protects the interests of the FHWA, the agency, and the public.

- The State of South Dakota does not have any laws that impose specific rules or requirements on certifications of materials. The DOT's obligation to the FHWA on federal aid highway projects is to certify that the materials used and the construction complied with the plans and specifications, project by project. The letter that certifies to the FHWA is signed by the Chief Materials Engineer.

1.4 Conclusions

This study indicates that many things are being done successfully in the certification system of the Department. Still, there are opportunities to improve the certification processes and how they are used.

The written procedures for certifying various materials are generally adequate to protect against poor materials being used in construction. These procedures compare favorably with many of the states surveyed, particularly those in your geographic area and those with similar traffic volumes and loads.

In practice the procedures are not followed in all cases. This is likely because the people involved do not feel the effort is warranted. The reasons given for not following procedures include the ideas that there are: duplications of certifying and testing of some materials; no verifications of certifications so there is no activity which encourages a supplier or contractor to be honest if they have an inclination not to be (we heard no "accusations" that contractors or suppliers have actually tried to be dishonest); no penalties for contractors who do not provide the certifications before the materials are used in the projects; lack of time during the construction so activities with more perceived value are done instead.

Umbrella certifications are an acceptable means of handling systems under a single certification. There are several areas that are considered to be candidates for an umbrella certification:

- Guard rail systems,
- Traffic signal systems,
- Lighting systems,
- Chain link fencing,
- Buildings, rest area, and
- Signing and delineation.

The benefit of an umbrella certificate is Department labor savings. It will not significantly reduce the contractors or vendors labor requirements, but will simplify compliance with the requirements. Inspection is still a necessary component of a successful umbrella certification system.

New certification processes must balance the process cost to suppliers, contractors and the Department against the risks and costs of damage in the event of a failure of certification process to prevent a materials failure. Thus, several certification processes, with differing detail levels for material evaluation and certification verification, are appropriate.

The legal and regulatory requirements are not a hindrance to changes since the requirements are left up to the Department to establish, subject to FHWA approval.

1.5 Recommendations

We recommend the Department build on the good processes in place, with changes to reflect the lack of failures in products and materials. Communicating the revised processes to the entire industry will gain acceptance of the revisions and reestablish the need and importance of certifications. Suppliers, contractors and Department staff should be trained so the revised processes are followed properly and function as intended because they have a smaller "safety factor" than the existing written processes. There is less redundancy, less testing and more reliance on supplier or contractor information. Monitoring the revised processes should make sure they are accomplishing their intended purposes and find ways for further improvement.

1. *Top Management Support:*
   Implementation must begin with a top management decision to support a revised, renewed emphasis on certifications and to accept the limited risks involved in reducing certification requirements. The support requires making policy changes, communicating them strongly and regularly, and allocating the financial resources to provide recommended equipment and training.

   Policy changes are needed to support the new procedures. Top management should not adopt new procedures if they are not willing to enforce policy changes. A critical example is the current policy of allowing the contractor to install materials and be paid for them before certifications are provided and approved, even though the written procedures do not allow installation, much less payment, without certifications. The new processes go part way to accommodate existing practice by requiring certifications before payment, giving the contractor and field engineer a little more time to complete their parts of the process. It is our opinion that having such a serious "deadline" will cause the processes to be followed. Other similar policy changes are necessary for success of the processes.

   Top management must put in place the policies and procedures that make following the new procedures a part of the appropriate staff job descriptions. This fits four of the five "key measurement areas" the Department has recently initiated - cost, timeliness, rework, customer satisfaction. The conduct of those procedures must be measured and evaluated regularly to emphasize the value of the certification process. It is an accepted maxim "that which is measured improves." The importance must be reiterated periodically by all management levels so the procedures do not fall into ineffective activities.

   The recommended revisions will reduce the current written requirements for testing materials. This implies an increased risk of poor materials being incorporated into roadway construction. If that does happen, there will be costs associated with corrections and possible liability for damages to the traveling public. However, it is our opinion that the risks are minimal and the

reduced costs associated with the recommended changes will exceed the possible increased costs if failures would occur. This opinion assumes that the recommended changes are fully implemented, particularly including the certification verifications. The risks may actually be reduced from the way the procedures are currently implemented, since the current written procedures are not being followed completely and having procedures and not following them creates more Department liability risks than not having procedures.

To be successful the revisions will take an investment in time and money. New computer equipment is suggested to save time. Top management must direct mid-level management to allocate the necessary staff time for training and conducting the revised procedures at the correct time in the process. The findings suggest that the estimated investment will pay back in time savings within one, or possibly two, construction seasons.

2. *Umbrella Certifications:*
We recommend a new "umbrella" certification process that would require contractors to maintain a complete record of sources and individual component certificates used for system construction and issue an "Umbrella Certificate" that lists the system components and the certificates provided to the contractor for those materials.

This will shift responsibility for documenting material acceptance to the contractor. The Department would have the right to inspect the contractor's records on a 48-hour notice. The Department would continue to be responsible for inspecting the system construction and the proper material use. We strongly advise that random testing be conducted of high-strength bolts, rails, cables and other structural components. Where possible, immediate field tests should be devised. An enforced sampling and testing policy not only will give the contractors more incentive to meet the specifications but will also improve the Department staff morale.

There are several areas that could be considered candidates for umbrella certification:

- Guard rail systems,
- Traffic signal systems,
- Lighting systems,
- Chain link fencing,
- Buildings, rest area, and
- Signage and delineation.

3. To replace specific certifications which the Department feels are not really necessary, we recommend a "contract certification" to be signed by individuals of the contracting firm stating that the firm has installed materials and products that meet the requirements of the specifications.

4. *Tiers:*

The Department's current acceptance methods should be continued but with some redefinition based on how a method is verified. Several methods are available to accept materials supplied to projects. We recommend the following five methods.

A. Manufacturer Certificate
B. Approved Product List
C. Certified Plant
D. Certified Supplier
E. Umbrella Certification

These methods should be subdivided by four verification levels. The verification level should be based on the importance of the material to the overall performance of the project, and to health and safety concerns. Four levels of material verification provided under any of the above methods are recommended as follows.

1. Random Sampling and Testing
2. Visual Inspection (DOT-25)
3. Random Audit
4. No Verification

This results in 20 possible certification processes. We do not anticipate the Department needing all of those possibilities. Further, several of them are very similar in nature and with a DOT-14 list to keep the processes identified with the materials and uses, and with training of the people, the complexity should be very manageable and the flexibility will be beneficial.

5. *Communicate the New Process to the Industry:*

The Department's new requirements must be clearly communicated to the industry before the processes are made a part of projects.

Presentations should be given to various segments of the industry, including the Association of General Contractors (AGC), suppliers and consulting engineers. The presentation should be about one-half hour long and should emphasize the Department's commitment, the processes, policy changes and how it will impact various industry segments. This must be followed by specific training.

6. *Training*:

Department staff, consulting engineers, contractors and vendors must be adequately trained in the new processes. All participants should understand the general certification procedures so they know how their activities contribute to the total system. They may not need to know the

details of activities in which details they are not involved. The process details must be taught to those who have to manage and execute the processes.

This report includes recommended training materials and visual aids that will facilitate learning and understanding the revised procedures. Flowcharts document and demonstrate the processes. Written text also describes the processes and gives the rationale for the revised processes. Training activities will require two to three hours of presentation, discussion and working through examples.

We recommend the Certification Engineer be responsible for this training. It should be completed before new processes are included in projects.

7. *Contractor Payments:*
We recommend that materials furnished and installed not be paid for until the Department has received the appropriate certificate for the materials provided. Alternatively, the withholding could be some percentage of the payment.

8. *Project Engineer Documentation:*
For selected materials and uses, we recommend the Department continue with a formal process of verifying materials acceptance with the Record of Visual Inspection and Field Measurements (DOT-25). For items that currently require a certificate or are on the Approved Products List, we recommend a form be developed based on the DOT-14, that the field staff can use to indicate the material was furnished, met specifications, had a certificate or was on the APL, and has room for a short comment. A similar process can be used for Umbrella Certifications.

9. *Modify the Materials Manual and Specifications as necessary and seek FHWA Approval:*
The Department, through the Chief Engineer's office, should revise the specifications and plans which state the requirements where necessary to implement the changes. This should be planned for a date after the necessary training has occurred and the equipment acquired. We recommend beginning with projects starting after June 1, 1999.

Specification changes we recommend for improving the certification processes are in the body of the report (Task 9).

The Chief Engineer should submit the revised certification program to the FHWA for their review and approval. This will be required before the changes can be used in new projects. This action will accomplish the necessary legal requirements for the revisions. We recommend this be done in January, 1999.

23 CFR requires that FHWA review and approve the certification processes of the states for federal funding eligibility. Once the processes are approved, the states must be able to show that they are following the processes during an FHWA audit. The recommendations for changes are generally similar to what is being done in other states so we expect that approval will be relatively simple.

10. *Automation:*

We recommend that the Department pursue its automation goal to reduce future costs. The DOT-14 forms should be integrated into the Department's software that enables the forms to be generated from the plans and materials lists, and be integrated with the construction measurement and payment systems. Field staff should have access to computers that are, or can be, linked to the central database for the purpose of entering material tracking and testing information and to query the status of the materials tracking and testing. The system should be capable of identifying the method specified for material acceptance such as certificate, Approved Product List, etc., when and where the certificates were delivered, when the materials were inspected for certificate conformance, and when the certificate was approved.

11. *Monitor the Process:*

We recommend that the Certification Engineer continue to be responsible for monitoring the new processes. Monitoring will provide the data necessary to identify areas where the process is not being followed or is not working, and will provide a basis for future system improvements.

12. *Accountability:*

People must be held accountable for their responsibilities in a clear, definite manner. The execution of their parts of the processes should be measured and regularly evaluated.

For Department staff this would be part of their performance reviews. Contractors could be barred from bidding for certain lengths of time. Vendors could lose their position on Approved Product List, etc. At a minimum, all should have additional formal training if performance is not acceptable.

Chapter 2
Research

2.1 Problem Description

This research was undertaken because the South Dakota Department of Transportation (Department) and contractors invest considerable time and energy on the various certification processes necessary to meet construction project requirements. When the processes are not followed carefully, the results include increased time spent, inadequate documentation, and loss of process credibility. Process improvements could save time and money, reduce frustration and possibly improve the constructed product.

Certifications of the highway construction materials are an important part of the engineering, legal and regulatory requirements of building and maintaining a highway system. Certifications indicate the materials and products used in construction are what was specified by the designer. They protect the user, State, engineer and contractor from the problems that would arise out of poor materials. Certifications are part of the process that requires all bidders to bid on the same thing and also reduces the amount of field testing.

The large variety of materials, products, suppliers and industry standards creates a large, varied need for certification processes. Some products are a small part of a larger quantity that is mass produced. Some products are specifically project fabricated. The multiple certification processes add to the cost of construction and construction management. Certification failures which show in materials failures can result in many complications, from having to remove and replace inadequate materials to accepting materials after they have been installed.

The risks associated with certification failures are not the same for all materials or products. Thus, a uniform level of effort for all certifications may not be justified.

The purposes of this study are to:

- evaluate the needs of the user, materials industries, contractors, and the Department and the problems they are experiencing with the existing processes,
- evaluate the processes used by the Department, other states and private enterprise, and
- recommend ways to improve the Department's processes to be more cost-effective while meeting engineering and legal requirements.

The form of certifications of the acceptability of materials and products is described in the specifications used by the designer for describing the highway or bridge to be constructed, maintained or

rehabilitated. Historically, the specifications have prescribed materials and methods to be used in construction. Manufacturers, suppliers, and fabricators can certify that a material, item, or system conforms to certain established criteria. A certificate does not measure the actual performance of the completed construction; successful performance is implied by certifications.

The "materials and methods" specifications and certifications require a great effort -- testing in significant detail each material or product used in the contract. Since there is such a wide variety of materials in the typical highway or bridge construction project, a myriad of procedures is required. It is necessary to accomplish and document acceptability in a process that can be defended in court in the event of disputes between parties of the construction process.

Currently, some state agencies, including the Department, are exploring new forms of specifications such as performance-related[2], end result, or quality assurance specifications. These give more responsibility and authority and interim control to the contractor for means and methods and materials. One of the advantages of these types of specifications is that the need for detailed testing and certifications is reduced. Further, some studies have concluded that the end-result or statistically-based specifications result in better construction.[3]

Private enterprise is also using a relatively new approach based on total quality management methods which require a contractor or supplier to have a defined process to prevent errors, as opposed to the traditional method of a quality process which is intended to catch and correct errors. One of the best-defined approaches is the ISO 9000 system used in European countries. Systems in America and Japan are similar in concept but are not uniformly defined. These approaches of preventing errors have the potential to greatly reduce the certification processes required for a specific project.

The Department has two avenues for improving their materials certification processes. They can improve the existing processes, continuing to use the same form of specifications, or they can change to new forms of specifications and the new types of certifications which would be used to measure the acceptability of the constructed item.

Possible "new" forms of specifications and certifications could involve warranties of performance, certifications backed by statistical process control data, lists of vendors qualified based on vendor quality management programs, and possibly others. Random testing and auditing of contractor certification files will remain a necessity. We feel, as the panel apparently does, that there needs to be some form of Department certification verification to maintain the integrity of the systems.

2.2 Objectives

The Request for Research identifies two broad research objectives which, when achieved, will result in a successful study. The stated Research Objectives are:

1) *To define the legal and regulatory requirements of a material certification process.*

2) *To develop alternative strategies for certification which will be simpler to administer, save time and be cost effective while addressing specific material requirements.*

To study and improve processes it is first necessary to identify the legal and regulatory basis for the processes. The engineering requirements must also be met. The legal and regulatory requirements are part of the contracting system by which all construction is obtained. These requirements include laws, state and federal regulations, and the case law developed in the courts as a result of conflicts over the meaning of material and product certifications. Engineering requirements define the expected material or product performance in the context of the entire constructed project. Before the processes can be meaningfully evaluated and improved, all requirements must be defined and understood.

This report (Task 5) defines the legal and regulatory requirements, which are surprisingly flexible and open.

When the requirements are defined and understood it will be possible to develop alternate strategies for certification. The strategies could include improvements to the existing processes or complete changes to new processes for certain materials or products. New forms of certifications may be proposed to make the processes more effective. The improvements would be intended to eliminate problems, match the effort expended to the risks associated with wrong decisions, continue to meet the legal, regulatory and engineering requirements and save time and money for the industry, contractors, and the Department.

In tasks 6 through 9 the study reaches the conclusion that certification processes can be simplified with policy and specification changes and can be made more effective through training and accountability.

Chapter 3
Task Descriptions

3.1 Introduction

The following paragraphs describe each of the tasks, how each of the tasks were done, if they were accomplished totally or only partially, their technical significance, their relationship to the objectives of the study, and any deviations from the proposed study.

Task 1

> *"Meet with the technical panel to review the work plan and survey questionnaire for the research."*

In preparation for the meeting with the technical panel, we searched the literature for relevant information about this problem. The search included references available from American Association of State Transportation and Highway Officials (AASHTO) and the Transportation Research Board (TRB). We were only able to find three publications that dealt with certifications. We understand that Department staff were not able to find significant published sources either. A 1982 study[1] of the problem disclosed many of the same problems expressed by the technical panel and Department staff. This report also concluded that a certification program could not be expected to succeed without provisions for verification of the validity of the certification document by random testing of the material.

Some of the Department's manuals and published documents were provided to us. We reviewed these prior to the meeting.

The proposed questionnaire for the survey of Task 4 was drafted and submitted to the project manager for review by the technical panel and discussions in the meeting. We also provided a draft meeting agenda with issues, responsibilities, actions needed or anticipated, and estimated timing.

The meeting with the technical panel was held on October 2, 1996, at the AGC office in Pierre, South Dakota. Each task of the work plan was reviewed to provide a better understanding of the perceptions of the problems and the proposed activities to address the tasks. Each panel member was able to present their views and concerns regarding the project. The draft questionnaire was discussed. Several very helpful comments from the panel improved the questionnaire. A list of people to be interviewed was also developed.

A final panel question gave good insight into their expectations about what would be required for the project to be a success.

Those attending the meeting included:

Dan Johnston, Research Office
Jim Keyes, AGC Executive Vice President
John Jund, Certification Engineer
Leonard (Pete) Peterson, Operations Engineer
Linda Peterson, Data Services
Brett Hestdalen, FHWA
Cameron Kruse, Braun Intertec
Greg Fuller, Bridge Construction Engineer
Daris Ormesher, Office of Research
Harold Skatvold, AGC President
Paul Mechling, Rapid City Region
Jim Holzworth, Asst. Construction Engineer
Erland Lukanen, Braun Intertec

Bill Francis, Construction Materials, Inc., was not able to attend.

After the meeting we provided minutes which included a summary of the discussions, decisions and responsibilities for future action.

This task was completed.

Task 2

> *"Review SDDOT's current specification requirements for certification and available literature on material certification."*

The information obtained during the course of the research came from five sources:

- DOT documents including the Materials Manual, Specifications book, and other documents. (Task 2)
- A literature search of transportation information databases. (Task 2)
- Federal procurement regulations relevant to state DOTs. (Task 2)
- Questionnaire sent to the Materials Engineers of all the state DOTs. (Task 3)
- Interview with DOT staff, contractors, and Suppliers. (Task 4)

Each of these sources provided different perspectives regarding the certification process.

South Dakota Regulations, Manuals and Documentation

The documentation reviewed included the following.

1. *Standard Specifications for Roads and Bridges,* South Dakota Department of Transportation, 1990 Edition.
2. *Materials Manual,* South Dakota Department of Transportation, including Revisions dated March 1996.
3. *Project Construction & Contract Administration, Business Area Analysis, Final Report,* South Dakota Department of Transportation, May 1995.
4. *Special Provisions,* South Dakota Department of Transportation, List dated May 28, 1996.
5. *Approved Products List,* South Dakota Department of Transportation, April 1995.
6. *Materials Certification Process,* South Dakota Department of Transportation, August 22, 1996, and accompanying DOT-14 for Projects NH-P029-3(75)78, P-1368(12), and P-1368(00).
7. *Essential Testing and Inspection Levels,* SD91-05, Prepared by Bergstralh-Shaw-Newman, Inc. for the South Dakota Department of Transportation, April 1992.
8. *Product Evaluation,* SD95-02, South Dakota Department of Transportation, Visual Aids for Project Presentation.

Federal Highway Administration Regulations and Documentation

There are several federal documents that relate to highway agency's procurement of materials for highways.

1. Title 23, Code of Federal Regulations (23 CFR). Government Printing Office, http://www.access.gpo.gov/index.html

2. *Acceptance of Materials, FHWA Technical Manual T 5080.11,* Federal Highway Administration, April 6, 1989.

3. *Materials Sampling and Testing,* FHWA Technical Manual T 6120.2, Federal Highway Administration, U.S. Department of Transportation, September 7, 1984.

4. Title 15, Code of Federal Regulations (15 CFR), Part 280. Government Printing Office, http://www.access.gpo.gov/index.html

5. *Materials Course for Highway Engineers, Materials Manual,* Manual for Training Course No. 13109, Federal Highway Administration, Washington, D.C., October 1994.

A contact in the FHWA was Mr. Roger Surdahl (HNG-23) in the Construction and Maintenance Division at Room 3211, HNG-23, 400 Seventh St. S.W., Washington, D.C. 20590 Telephone 202-366-1563 and FAX at 202-366-9981. Mr. Surdahl provided full copies of numbers 2,3 and 5 above.

Literature Search

The most significant literature resource is *Material Certification and Material-Certification Effectiveness,* National Cooperative Highway Research Program Synthesis of Highway Practice No. 102, Transportation Research Board, Washington D.C., November 1983.

Catalog of Materials Requiring Certification or on Approved Products List

We cataloged the Department certification processes identified in this task. Materials or products requiring certification, or on the Approved Products List were tabulated, and the relevant processes that are involved were identified. This table is included in Appendix A.

Table 1 identifies what the contractor's requirements are regarding supplying material to a project, and what the Department's requirements are regarding the acceptance of the material. Three contractor requirements are listed:

- Certificate,
- On the Approved Products List, or by Certificate, or
- On the Approved Products List.

The Departments's acceptance requirements for materials requiring certifications are grouped as follows:

- Certificate and Sample,
- Sample if a certificate is not available,
- Sample plus document on a DOT-25, or
- Document by a DOT-25.

In all, there are 50 materials categories that require certificates -- 17 material categories require sampling (and assumed testing), 20 material categories require documentation on a DOT-25 form, and 14 materials that do not have any additional requirement. Most of the material categories require either a sample or a DOT-25 except seed which requires both.

Legal, regulatory and engineering requirements are discussed in the chapter dealing with Task 5.

We believe we have completed the scope of work as defined in our proposal and have completed a search adequate for the purposes of this study.

Task 3

"Conduct a survey of other states' material certification processes."

Survey of State Highway Agencies

A survey questionnaire was developed with the help of the technical panel. A mailing list was developed from the AASHTO listing of Materials Engineers contained in the *1996-1997 Reference Book of Member Department Personnel and Committees.* (A copy of the survey, along with a compilation of the results) is contained in Appendix B. Calls were made to 20 of the Materials Engineers to alert them the survey was coming and to determine the correct person to send the survey to. The mailing list was subsequently updated to reflect the results of the telephone calls and the surveys were sent out mid December 1996. Thirty-two responses were received by the end of January, which were summarized. Six more surveys were received after the summary was completed, making a total of 38 surveys received, a 76 percent return. Table 1 is a summary of the results of the survey. Table 2 is a summary comparison of the Department's requirements for certificates compared to the other states. All the responses to the questions are contained in the Appendix B.

Highlights of the survey show that:

- all state transportation agencies rely on certifications or Approved Products Lists,
- a majority of agencies conduct some sort of verification testing,
- Sixty-eight percent of the agencies that responded to the question on improvements (55 percent of the questionnaires returned) indicate that the agency has made improvements in the certification process,
- Fifty-seven percent of the respondents indicate they use some sort of package certification.
- Five out of 33 that responded to the question, stated that they use warranties in lieu of certifications. Washington uses warranties for turnkey building projects. Wisconsin uses them in lieu of a missing certificate. Mississippi referred to lighting and traffic items which are outside of their materials area of responsibility. Missouri is experimenting with warranties on a performance basis. Oregon requires one year warranties on bridge paint and 10 years on permanent sign sheeting. South Carolina has 180-day warranties on traffic paint and thermoplastic. Utah is using warranties for traffic markings on an experimental basis. Texas says it would be counterproductive to use warranties on lighting fixtures.

Table 1. Summary of Survey Responses

Are Certifications used for accepting any of the following materials? Check Yes or No.			How are Certificates Accepted			How are Certificates Verified				
Material	Yes	No	Always	With Limits	by APL	Not Verified	Random Tests	By Others	Com-mercial	Site of Mfg.
Air Entraining Agents	31	6	1	3	28	5	17	3	10	--
Antistrip Additives	12	16	--	2	12	3	7	--	1	1
Asphalt Cement	27	10	4	5	14	--	24	--	3	8
Asphalt Emulsions	26	11	4	5	14	--	24	--	2	7
Coarse Aggregates	6	32	--	2	12	--	14	1	--	6
Fine Aggregates	6	32	--	2	11	--	14	1	--	6
Mineral Filler	9	23	1	3	5	--	9	--	1	1
Portland Cement	34	4	4	9	16	--	31	--	1	6
Reinforcing Bars	30	9	8	7	10	--	32	1	2	9
Structural Steel	31	6	7	13	5	5	9	3	7	11
Water Reducers	29	5	2	4	26	3	16	1	9	--
Bituminous Concrete	4	31	--	3	1	--	6	--	2	4
Bricks and Blocks	14	22	4	1	2	3	12	--	--	3
Concrete Pipe	18	19	3	5	6	1	12	1	1	14
Epoxies	26	9	5	3	19	5	14	1	5	--
Hardware, Guardrails, etc.	35	2	4	11	13	5	23	1	2	5
Incidental Concrete	9	24	1	6	2	--	5	--	--	2
Lighting Equipment	26	7	8	9	6	5	10	--	--	2
Metal Pipe	27	10	7	8	11	4	21	1	3	7
Paints	24	12	--	8	17	1	20	1	1	1
Signs	27	9	2	14	9	6	14	2	5	1
Structural Concrete	2	33	--	1	1	--	6	--	--	1
Traffic Signals	27	9	5	12	10	6	9	1	5	2
Geotextiles	31	7	6	10	12	3	16	3	6	2
Dust Control Chlorides	9	16	4	3	1	4	5	1	2	1
Gabions	20	11	5	5	4	4	10	1	3	1

Are materials installed before Cert. is approved?	23	10
Have you done anything to improve your cert. process?	21	10
Are warranties used in lieu of certifications?	5	28
Do you use package certifications?	20	15
Are there items that you accept without cert. or testing?	13	18
Do you have any other comments?	7	17

Table 2. Percentage of Agencies Using Certificates, by Material Type

Material	Respondents requiring Certificates	Certificate Required by SD DOT
Structural Concrete	5.7%	n
Bituminous Concrete	11.4%	y
Coarse Aggregates	15.8%	n
Fine Aggregates	15.8%	n
Incidental Concrete	27.3%	n
Mineral Filler	28.1%	n
Dust Control Chlorides	36.0%	y
Bricks and Blocks	38.9%	n
Antistrip Additives	42.9%	y
Concrete Pipe	48.6%	y
Gabions	64.5%	y
Paints	66.7%	y
Asphalt Emulsions	70.3%	y
Asphalt Cement	73.0%	y
Metal Pipe	73.0%	n
Epoxies	74.3%	y
Signs	75.0%	y
Traffic Signals	75.0%	y
Reinforcing Bars	76.9%	y
Lighting Equipment	78.8%	n
Geotextiles	81.6%	y
Air Entraining Agents	83.8%	y
Structural Steel	83.8%	y
Water Reducers	85.3%	y
Portland Cement	89.5%	y
Hardware, Guardrails, etc.	94.6%	y

The survey of other states was successfully completed. We received a high percentage of responses. This is a likely indication of the interest of all states in this issue.

Task 4

"Interview material suppliers, contractors and Departmental personnel involved in the material certification process to gain an understanding of our process and the informational requirements thereof."

Discussion and Interview Results

A number of people were interviewed during the study. Those interviewed included Department staff, contractors and suppliers. Within the Department, the interviewees included Central Office staff, Materials Engineers, Project staff and one Operations Auditor. Most of the interviews were conducted in person. One contractor from Rapid City, included on the interview list, was not interviewed because of their location.

The interviews were mostly in person and conducted by Erland Lukanen, Cameron Kruse or both.

The following is the list of people interviewed:

South Dakota DOT

1. Jerry Schaefer	Assistant Certification Engineer	Pierre
2. John Jund, Jr.	Certification Engineer	Pierre
3. Craig Glazier	Project Engineer	Custer
4. Dwight Pogany	Project Engineer	Pierre
5. Jim Olson	Project Engineer	Sioux Falls
6. Ron Dahme	Materials Engineer	Mitchell
7. Larry Engbrecht	Chief Materials and Surfacing Engineer	Pierre
8. Greg Fuller	Bridge Construction Engineer	Pierre
9. John Cole	Chief Bridge Engineer	Pierre
10. Linda Peterson	Information Management	Pierre
11. Leonard (Pete) Petersen	Operations Engineer	Pierre
12. Clyde Pietz	Director, Division of Operations	Pierre
13. Barton Banks	Legal Department Consulting Attorney	Pierre
14. Lynda Marzahn	- Operations Review	Huron
15. Larry Weiss	State Highway Engineer	Pierre
16. Norm Humphrey	- State Maintenance Engineer	Pierre
17. Tim Foerster	Assistant Specifications Engineer	Pierre
18. Jeff Senst	Area Engineer	Sioux Falls
19. Steve Rames	Engineering Supervisor	Sioux Falls

Contractors

20. Harold Skatvold	Buskerud Construction (Guard Rail)	Dell Rapids
21. Dan Pirrung Steven Christianson	Myrl and Roy's Paving, Inc. (Bituminous Contractor)	Sioux Falls
23. Tom Graves	Graves Const. Co. (Structures)	Sioux Falls
24. Dave Fleck	Sioux Falls Construction (Bituminous and Structures)	Sioux Falls
25. Kevin Buehner (Lighting) Sioux Falls	Action Electric	
26. Bill Ashton	Egger Steel	

Suppliers

27. Bill Francis	Construction Materials, Inc.	Minneapolis

Two suggested people were not interviewed. Carl Quist was not available. Instead, Barton Banks, a fee attorney for the state working in contractor litigation was interviewed by telephone. Bill Whitney of Stanley J. Johnson Concrete Constructors, Inc., was not interviewed due to lack of availability.

Significant observations and conclusions from the interviews are:

- Certificates are not handled in the manner prescribed in the Materials Manual.
- The handling processes have improved in the last two years.
- Many interviewees, both staff and contractors, question the value of the certificates as they are currently handled.
- Contractors receive payment for materials placed even if no certificate is available.
- The staff time required to handle certificates is minimal if the process is followed, but becomes significant if the process is not followed.
- Field staff do not feel empowered to enforce the certificate requirements as prescribed by the Materials Manual.

Figure 1 shows the written process as we understand it from the Standard Specifications and the Manuals. However, Figure 2 shows some of the deviations which appear to be common, based on information from the interviews.

Secondary issues that are strongly related to certificates include the RECORD OF VISUAL INSPECTION AND FIELD MEASUREMENTS (DOT-25) forms and the Approved Products List.

The DOT-25 forms serve several purposes as indicated by its two-part title *RECORD OF VISUAL INSPECTION* and *FIELD MEASUREMENTS*. The *VISUAL INSPECTION* seems to be the source of

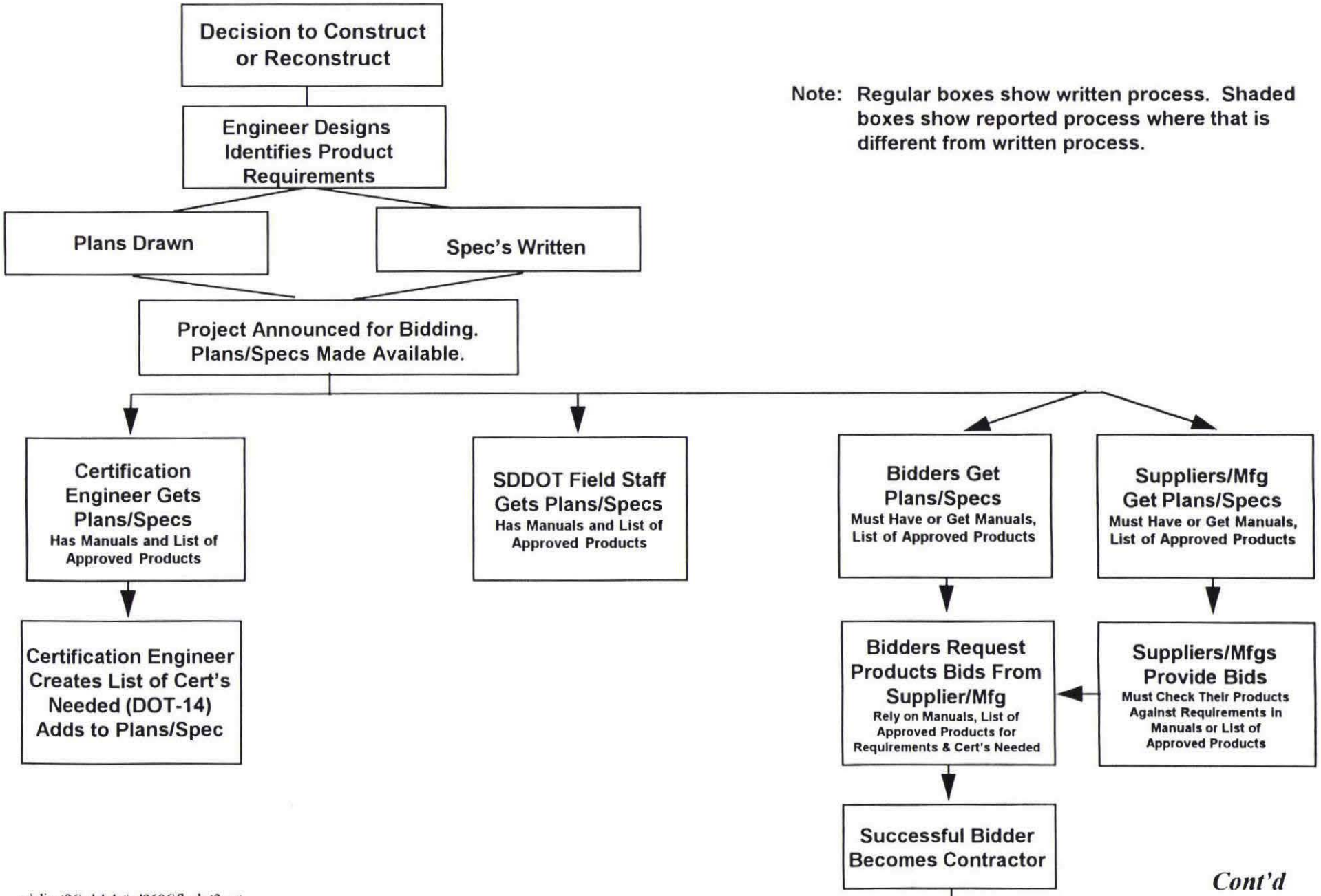
most of the controversy regarding the DOT-25. A majority of those interviewed would like to discontinue the use of the DOT-25 forms. When asked why, the issue became somewhat clouded; almost everyone agreed that the forms were not a problem if everyone stayed current. Also, everyone agreed that the documentation was necessary but no clear alternative was mentioned. Field Diaries were discussed, however, there does not seem to be a consistent process in place with regard to the use of diaries.

There was a general consensus among those interviewed that the DOT-25 forms were a duplication of effort, particularly when certificates were required.

The processing of certificates, the DOT-25s, and the materials on the Approved Products List, are interrelated. The header of Appendix A clearly shows the inter-dependency of these three items.

This task was adequately completed. We interviewed more people than was proposed. We were able to learn a great deal about the actual workings of the certifications processes, the attitudes and issues.

Figure 1. Existing Written Process for Certification



Note: Regular boxes show written process. Shaded boxes show reported process where that is different from written process.

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Figure 1. Cont'd

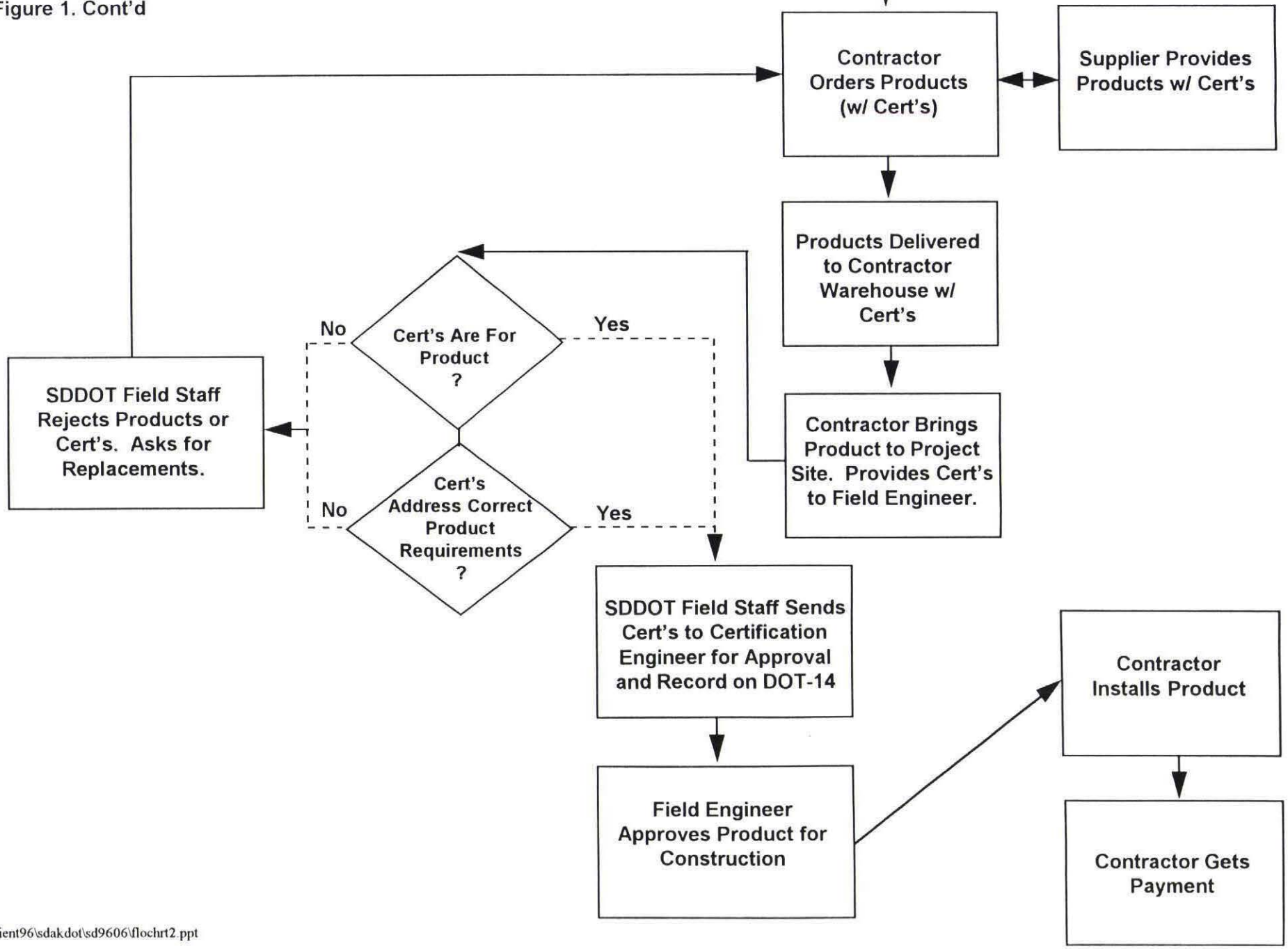

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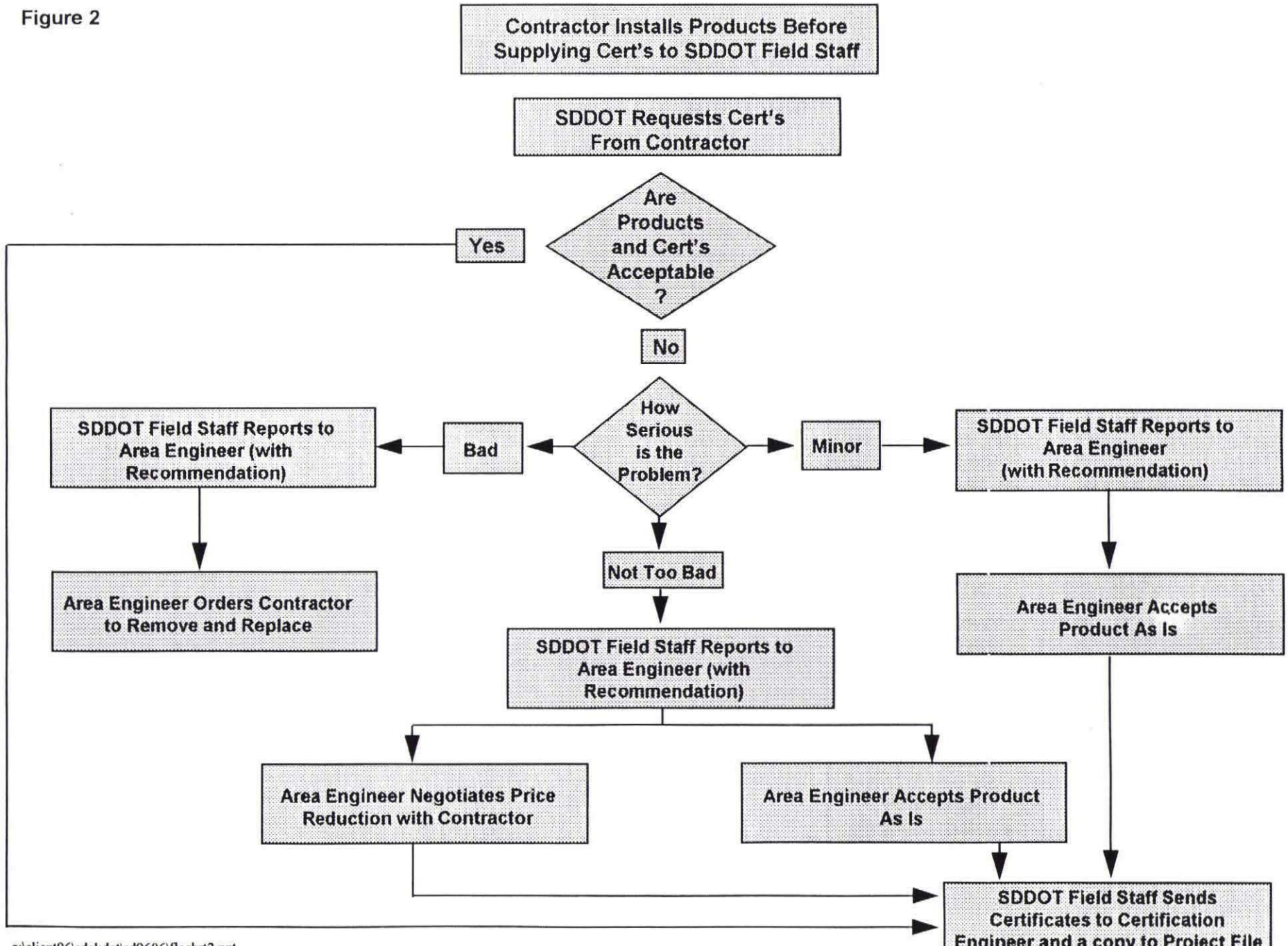
Figure 2



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Task 5

> *"Determine the legal, liability and regulatory issues which may affect any changes in our current process."*

The regulatory issues of the FHWA are described in 23 CFR, which states that any agency may represent the interests of the FHWA in matters of highway construction. In order to do so, the agency must have an established, and FHWA approved, operating procedure that adequately protects the interests of the FHWA, the agency, and the public.

The Federal Highway Administration has established requirements for Materials Sampling and Testing (Technical Advisory 6120.2) and for Acceptance of Materials (Technical Advisory 5080.11). Both of these documents refer back to the Federal-Aid Highway Program Manual (FHPM), Volume 6, Chapter 4, Section 2, Subsection 7. The Technical Advisory T 5080.11 states:

> Volume 6, Chapter 4, Section 2, Subsection 7, of the Federal-Aid Highway Program Manual (FHPM) sets out the policy and required provisions for sampling and testing of materials. The purpose of a materials acceptance plan is to assure, with reasonable risks, the material meets the specifications.

The Technical Advisory also divides materials into two broad categories - Manufactured Materials and Project Produced Materials. Certifications primarily deal with manufactured materials.

Since state highway agencies have accepted the role of overseeing the Federal-Aid Highway System, which includes design, construction, operations, and maintenance responsibilities, the FHWA requires that each state highway agency have a materials sampling and testing program that FHWA has approved, and the state agency certifies to the FHWA that the sampling and testing program has been followed and the materials incorporated into the project met specifications.

The *Materials Course for Highway Engineers Materials Manual* contains a section from the FEDERAL-AID POLICY GUIDE that contains PART 637 - CONSTRUCTION INSPECTION AND APPROVAL of the 23 CFR, plus a NON-REGULATORY SUPPLEMENT to specific parts of PART 637. Two sections of the non-regulatory supplement deal with certificates:

1.b. Verification/check samples and tests - those samples and tests performed by State personnel to verify the results of certified tests or the manufacturers' certifications or specification compliance for manufactured materials.

3.f. The State should be encouraged when developing its program to make provision for acceptance of small quantities of noncritical material on the basis of visual inspection or by the manufacturers' certification.

Title 15, Code of Federal Regulations (15CFR) Part 280, has Federal regulations which pertain to certifications of high strength fasteners. The code establishes a detailed process for a manufacturer's certification using accredited testing laboratories, grade identification markings, and written documentation. It also establishes violation of the code as a criminal act with injunctive relief against individuals in addition to the firms involved.

The South Dakota Department of Transportation has an FHWA approved materials process and provides certification letters to FHWA on Federal-Aid highway projects. Even though the non-regulatory supplement refers to using certifications for ".. small quantities of noncritical material..", it is clear from the basis of the FHWA's approval of the Department's policy, and the results of the survey of other states, that many materials have been included in this category.

The State of South Dakota does not have any laws that impose specific rules or requirements for acceptance of materials. The Department's obligation to the FHWA on federal aid highway projects is to certify to the FHWA that the materials used, and the construction, complied with the plans and specifications, project by project. The letter that certifies to the FHWA is signed by the Chief Materials and Surfacing Engineer.

Methods of certification of materials and products are included in several areas of the Standard Specifications and the Manuals of the Department. In the Standard Specifications, section 2.14 Material Guaranty has a broad statement which requires the contractor to provide materials which meet the specifications. Section 5.3 Conformity With Plans and Specifications also has a broad requirement that materials furnished shall conform to the requirements. This makes the contractor responsible regardless of any other request for certifications.

Thus, certifications could be totally eliminated without reducing the legal requirement of the contractor to provide materials and products that meet the specifications.

Certifications are, however, a part of the quality control/quality assurance processes of constructing a project in accordance with the design. They are, in part, "standard engineering practices" which all

professional engineers must follow to meet the responsibilities of their professional registration. They are "standards" when they are uniformly practiced by "competent" engineers. From the survey of other states it is difficult to say what levels of certification are uniformly practiced so it would be difficult to establish any specific certification practice as "standard." Further, if a certification practice is the considered opinion of the collective engineering of the Department there would be strong evidence that the practice is a standard. Thus, it appears that the engineering considerations of certification practices are relatively flexible and controllable by the Department.

From the legal and regulatory information available it is clear that the federal and state requirements on the Department are broad and relatively easy to satisfy. The Department is in a position of being able to establish the acceptance requirements they wish to use.

We believe this task was adequately completed.

Task 6

> *"Examine the feasibility of umbrella, component or other methods of certification by contractors of materials currently accepted on the basis of itemized manufacturer's certification only."*

"Umbrella" Certifications

Umbrella certifications are an acceptable means of handling systems under a single certification. Thirty five of the 38 surveys received responded to the question on "package" or "umbrella" certification. Of those 35 responses, 20 agencies checked the "Yes" box indicating they do accept umbrella certifications while 15 agencies checked "No."

In a broad sense, the Department accepts some products that are made up of a number of separate components under a single certification, such as concrete pipe. The quality of concrete pipe is dependant, not only on its component materials, but also on the manufacturing process; certifying the plant is similar to a umbrella certification issued by a contractor with some significant differences. Another example of the "blanket" certification is the Letter of Certification by the Chief Materials Engineer to the FHWA for Federal-Aid projects. That letter certifies that the materials "were in

conformity with the approved plans and specifications; and such results compare favorably with the results of the independent assurance sampling and testing." The letter goes on to list exceptions, if necessary.

There are several systems that the Department can consider as candidates for an umbrella certification:

- Guard rail systems,
- Traffic signal systems,
- Lighting systems,
- Chain link fencing,
- Buildings, rest area, and
- Signing and delineation systems.

Other systems that have been identified under the umbrella certification process in other states include Mechanically Stabilized Earth (MSE) wall systems, plastic drain pipe systems, and plastic conduit systems. It is our opinion that MSE wall systems are not yet routine in construction and need close observation and testing. Situations where failure of a wall would not impact pavements or bridges may be suitable for umbrella certifications.

The benefit of an umbrella certificate is labor savings for the Department, and possibly the contractors. The current process for guard rails is to require certificates for each of the components, requiring the contractor to collect and deliver a large number of certificates to the Department field staff. The stated process requires the field staff to take possession of the certificates, verify that each of the materials supplied by the contractor are represented by the certificates, verify that the materials conform to project requirements and take random samples for testing to validate the certifications. Required field verifications are not routinely being done.

A guard rail specification, using an umbrella certification, would require the contractor to maintain a complete record of the sources and certificates of the individual components used, issue a system certificate listing the component of the system and the certificates provided to the contractor. The Department would retain the right to inspect the contractor's records on a 48-hour notice. The Department would continue to inspect the installation of the guard rail system and the proper use of materials. Components which cannot be adequately identified in the field (type, lot, heat, etc.) should not be included in the umbrella certification process. We strongly advise random testing of the high

strength bolts, rails, cables, and other key components as necessary. An enforced sampling and testing policy not only will give the contractors more incentive to meet the specifications, but it will also improve the morale of the Department's staff.

Guard rail contractors and electrical contractors generally buy many of the items used in the fabrication of their systems in bulk. For example, a bulk purchase of high strength bolts will come with a certificate regarding the bolt properties. These bolts will be used on a number of systems, and likely on a number of projects. The current practice requires that the contractor provide the Project Engineer with certificates for all of the components used in the guard rail system. If the contractor is using components from several bulk purchases, the number of certificates increase accordingly, resulting in a need for a set of the same certificates for each project the materials are supplied for.

Inspection is still a necessary component of a successful umbrella certification system. The Department must confirm that proper materials are used and are installed correctly. Guard rail, traffic signal, and lighting systems all contribute to the safety of the traveling public the Department will need to continue to make a dedicated effort to assure that these systems will perform as intended.

Figure 3. Umbrella Certification

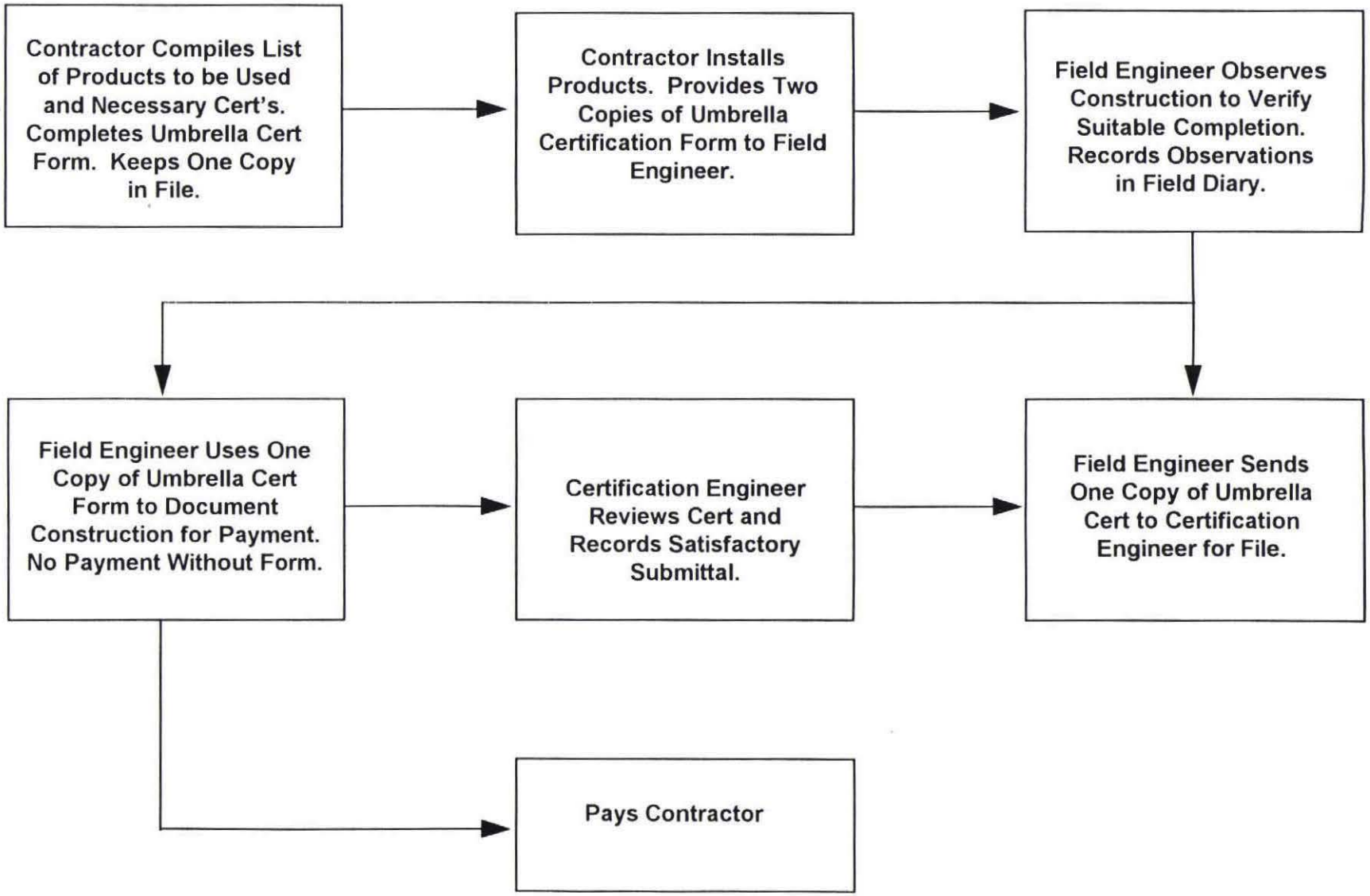

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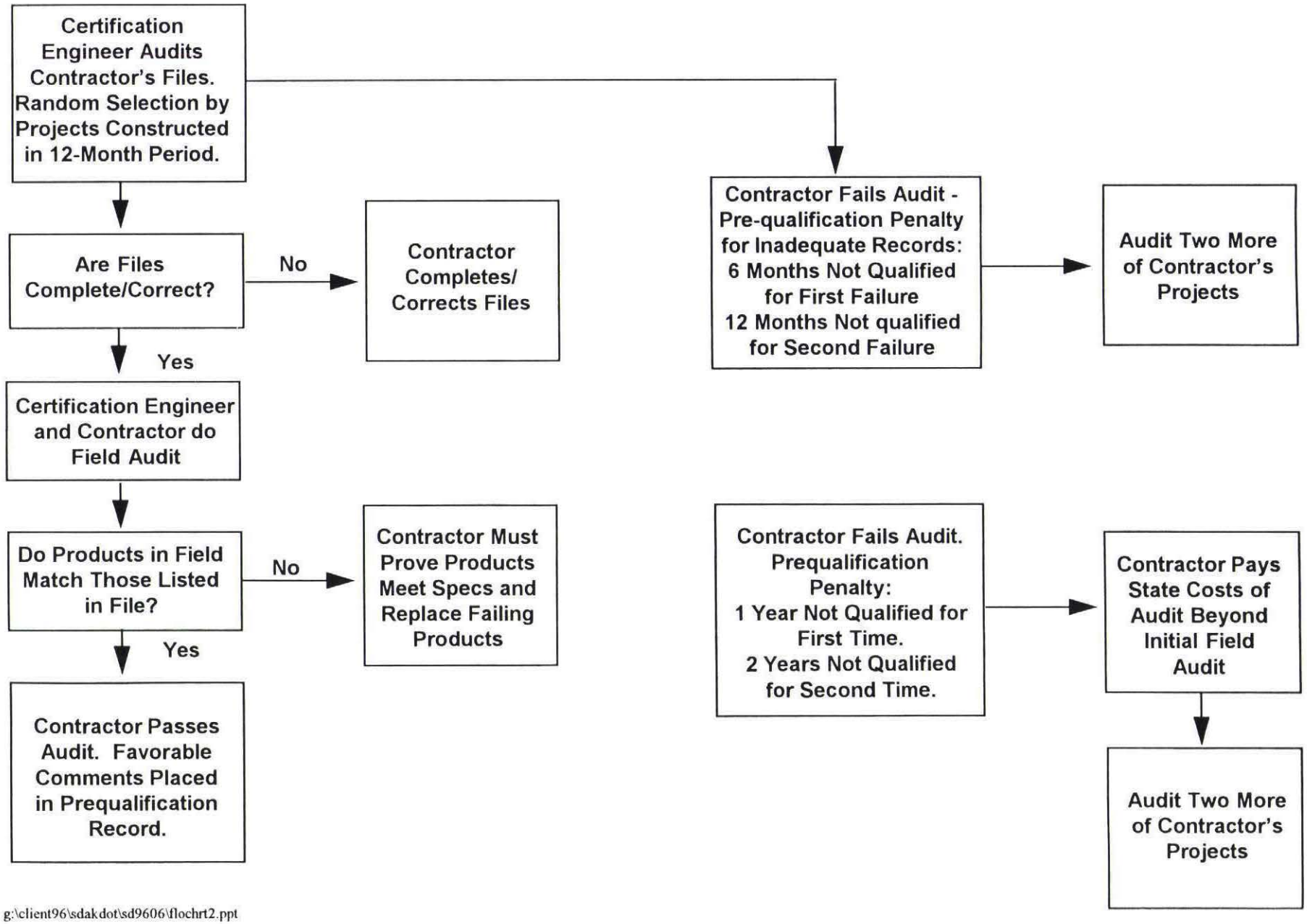
Figure 4. Umbrella Certification Audit



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Specific issues that were brought up by the technical panel, and by some of the staff members that were interviewed are:

- What protection does the Department receive from a blanket certificate that the contractor provides for a system?

  The certificate by a contractor can state that the contractor requested and received all of the manufacturer's certificates, used the proper materials, and assembled or installed the system in conformity with the plans and specifications. To provide the Department with a means of protection, the specifications must establish additional requirements of the contractor, such as requirements to keep certifications and records, and to make them available for inspection by department staff subject to a reasonable notice period, such as 48 hours. The Department, in turn, must inspect the systems to confirm that proper materials were used and that they were installed correctly. Random sampling of select components from the systems is recommended.

- What recourse does the Department have if faulty materials were used and the contractor is no longer in business?

  The situation would be no different than it is now. The bonding company holds some responsibility while the contract is in force, as they do now. Once the contract has been finaled, the liabilities would be no different had a blanket certification been used or not.

Package or Umbrella certification processes from several state agencies were reviewed. The way package certifications are handled varies considerably.

Kentucky states it has a package certification for Guard Rail. The text in their *Materials Field Sampling and Testing Manual* requires the project engineer to insure that guardrail fabricator is on the Division of Materials Approved List of Guardrail Manufacturers and to "Obtain Manufacturer's certification... ... for all items in the shipment." The application, according to Mr. Jim Stone, Director, Kentucky Department of Materials, is acceptance as a package from an approved suppliers list that is certified annually.

Wyoming uses a four-copy, pressure-sensitive CERTIFICATION OF MATERIALS form that the contractor must complete. The bottom of the form contains a "Statement of Certification" block which the contractor must sign. The form lists several items that are accepted by certification. The method of acceptance can be different for each item listed.

Kansas has established five levels of certificates, Type A through E. Type E is the one of interest for this study. It states:

> Type "E" certifications shall be prepared by the fabricator to cover a composite item or structure incorporating two or more materials which have been previously approved on an individual basis for Department projects, but which lose their identity when they are incorporated into a composite structure. Such composite items would include signs, overhead sign structures, etc. The certification shall state that all materials used in the fabrication of the item or items in question were previously approved for Department use.

Washington stated in the survey that "Guard rail is certified by the installer for Rail elements, Anchors & Posts & Blocks. Bolts are A307s, which we accept without cert., so far No Known Problems, other items such as post-tension systems - except the strand or bar, which is tested separately."

Virginia and New York accept guard rails, with hardware, as a package. Suppliers are required to maintain a file of steel mill analyses.

Other Methods of Certification

A "contract certification" may have an application for the Department, particularly if the Department chooses to eliminate requirements for certifications of some materials and products. A contract certification would be a statement signed by a responsible representative of the contractor (and possibly subcontractors) at the end of the project that they have furnished materials and products that meet the requirements of the contract. This statement would create a personal responsibility for the materials and products over and above the "corporate" responsibility of the contracting firm.

The Michigan DOT's General Materials Certification Procedures reads "MDOT allows some highway materials to be accepted by the Project Engineer on the basis of the supplier's written certification that all applicable specifications are met."

Mississippi takes an interesting approach for small quantities in that they will accept small quantities of materials on the basis of a certificate from the Project Engineer or the producer. For the Project Engineer to certify the material the requirement is "Acceptance on the basis of visual examination provided the source has recently furnished similar material found to be satisfactory under the normal sampling and testing procedures of the Department."

Warranties are just starting to be used in some states. Paints and pavement marking materials were mentioned most frequently. There is not enough history to be able to judge the success of this system. Warranties differ from certifications in that most warranties measure performance rather than conformance to specifications. Since performance in a somewhat uncontrolled environment is hard to define the potential use of warranties appears limited. Warranties would be appropriate for a design/build/operate system which might be developed for lighting or signal systems (signal systems might have too high a liability for this approach).

Private industries are beginning to use quality management approaches that rely on process controls that prevent "failures" and document the processes extensively. A product or material is acceptable if it comes from a process that is "in control." Such systems are capable of producing higher quality, more consistent products or materials. Thus, buyers of the products can, in turn, create more consistent results. The number of suppliers of highway materials or products using these systems is limited at this time. The Department should continue to watch this development and specify that products come from manufacturers who have quality management systems as enough companies become available to create adequate competition.

This task successfully looked at the options available for types of certifications and identified the umbrella certification as a recommended process. It is completed.

Task 7

"Evaluate the needs for certification based on material types and usages."

Certain materials used in highway construction present higher risks if they fail in service, depending on how they are used. Steel used in bridge beams is an example of a high-risk use. Steel used in fence posts on the right-of-way line is an example of a low-risk use. Since a failure in the certification process could lead to a failure of the material in service it is logical that the level of effort spent on acceptance should be commensurate with the risks of failure and the associated costs.

This leads us to recommend certification processes having different levels of detail in evaluating the material and in validating the certifications accepted. In Task 8 we describe five processes with four possible levels of verification. The Department can assign various materials and uses to the specific certification process they feel fits the material and use and assign a verification level based on the risks associated with possible failure and the number of failures that have occurred in recent projects.

In Task 5 we have determined that the legal and regulatory requirements are left up to the Department to establish. Thus, we feel you do not have to be specifically concerned with meeting these requirements when establishing new processes. It becomes an issue of good engineering evaluations of the risks of failure. When you have made your recommendations to FHWA, and they accept them, new requirements will have been created. You then have to follow the processes you established to avoid legal and regulatory problems.

As the Department analyzes the engineering risks of failure of the materials in service we recommend you assign relative costs of failure associated with:

- personal injury and vehicle damage for highway users,
- time loss (inconvenience) for highway users,
- cost to repair the failure,
- "opportunity" cost of not being able to spend resources to repair or upgrade other parts of the highway system, and
- damage to the image of the highway system (negative impact on tourism and on resident highway users).

The potential for failure will be hard to document. However, sources of information you can use include:

- number of previous failures in service
- number of previous failures in the tests conducted to validate certifications.

The judgment of other engineers will be helpful. From the results of the survey of other states (Task 3) you can evaluate what other departments are doing to certify materials and uses. This likely represents "accepted engineering practice."

A drawback to using the current practices of other states is that one third of the states have not reviewed their practices or updated them to reflect new manufacturing processes and better overall control of manufactured products. Other states have updated part or most of their processes.

The data gathered during the surveys, literature search, and interviews provides several ways of ranking the importance of materials that are accompanied by certificates or are on an Approved Products List. One means of establishing an order of importance is to sort the materials by the percent of agencies that require some sort of sampling and testing of the materials provided. Table 3 was established by summing the number of agencies that positively responded to the center three columns under the general heading of "How are certifications verified?", including Randomly Sampled and Tested by State, Other Agency Tests Accepted, or Tests by Commercial Laboratories Accepted. The resulting order shows that the materials that are generally associated with structures receive the greatest amount of testing.

Table 3. Survey Materials Ranked in Order, Lowest to Greatest, of Required Testing

Material	Survey Test Ranking	Does SDDOT Certify?
Incidental Concrete	1	n
Structural Concrete	2	n
Antistrip Additives	3	y
Bituminous Concrete	3	y
Dust Control Chlorides	3	y
Lighting Equipment	6	n
Mineral Filler	6	n
Bricks and Blocks	8	n
Concrete Pipe	9	y
Gabions	9	y
Coarse Aggregates	11	n
Fine Aggregates	11	n
Traffic Signals	11	y
Structural Steel	14	y
Epoxies	15	y
Signs	16	y
Paints	17	y
Geotextiles	18	y
Metal Pipe	19	n
Asphalt Emulsions	20	y
Water Reducers	20	y
Hardware, Guardrails, etc.	22	y
Asphalt Cement	23	y
Air Entraining Agents	24	y
Portland Cement	25	y
Reinforcing Bars	26	y

The current behavior of good manufacturers and contractors is based on honesty and an intent to provide what is specified. However, if there is a contractor or supplier who wants to be dishonest they are dissuaded by the risk of being discovered. To the extent that the quality assurance of verified certifications is reduced by eliminating some certifications or verification testing, the risk of being discovered is also reduced. Unfortunately, because of the competitive situation if one contractor or supplier prices lower by taking more risks, others are forced to follow. This is a strong reason to continue to evaluate the performance of the certifications used.

This task was completed as far as the research can be taken. The Department now has to make decisions on the types of certifications that are most effective for various types of materials and products and the level of verification that fits the risks acceptable for the materials and products and how they are used.

You will also have to judge if the behavior of the manufacturers and contractors will change over a period of time if they perceive an easier time of providing substandard materials.

Task 8

> *"Develop methods for verification of material quality using revised certification processes."*

From the information developed in the previous tasks we propose a number of changes to the existing processes and one new process. Further, we will categorize methods of verification of the certification processes. The complexity and the number of products used in the construction of highways requires, in our opinion, a number of processes and verification methods for efficiency.

Simplification can be achieved by changing the certification processes used for specific products to a simpler certification process and using a verification method which is not as time consuming. You may wish to simply eliminate some certifications since there remains a blanket requirement in sections 2.14 and 5.3 of the Standard Specifications that the contractor provide materials that meet the specifications.

Table 4 presents a matrix array of Material Certification Methods and Verification Methods. Any particular material, or product, could be placed into any one of the cells in the array. There is no hierarchial order to the Material Certification column; however, there is a definite order to the Verification Method columns.

The differences between any of the methods of materials certifications are that they are different ways to document a quality control of the suitability of the product. The benefit of using a certification process, even when random sampling and testing is done, is to reduce the frequency of sampling and testing the Department must do.

The importance of the material, product, or system of materials and products to safe and effective highway service should dictate the verification methodology used. It should be remembered that the certification represents quality control testing of the product. The verification is a form of quality assurance testing.

Table 4. Sample array of Certification and Verification Combinations

Material Certification Method	Verification Method			
	Random Sampling and Testing	Visual Inspection and/or DOT-25 Document	Random Audit of Contractor Records	No Verification
Manufacturer's Certificate			Not Applicable	Not Recommended
Approved Product List	Not Recommended?		Not Applicable	
Certified Plant			Not Applicable	
Certified Supplier			Not Applicable	
Umbrella Certificate				Not Recommended

Methods of Verification of Table 4

We recommend that the use of random sampling for verification tests be continued for those products and materials which have a significant impact on safety or performance. We did not study the details of this process but understand it has been studied in another research project. This verification method has wide acceptance in government and private enterprise for critical elements.

We suggest the use of DOT-25 forms be studied for improvement, possible elimination, or replacement. Our recommendation regarding the "Visual Inspection" of the DOT-25 is to develop a form that is developed at about the same time as the DOT-14. This form would be provided to the project staff, and would be similar to the DOT-14. It would provide a place to record the date of visual inspection, name of inspector, if appropriate certificates are furnished, and a comment which, in most cases, should read "meets specifications." A copy of this form would be periodically sent to the Certification Engineer.

Automation of reporting would be a good way to improve the use of these inspections. We do feel it is appropriate to inspect materials and products before authorizing payment. We suggest the reporting could be combined with the payment authorization process at some time in the future.

A random audit of contractor files is only appropriate for the umbrella certification method because that is the only method which requires the contractor to maintain files. A random audit may be appropriate

for a supplier or manufacturer where they are on a list of certified suppliers or manufacturers but this would not be an audit of the contractor.

Our method of "no verification" is intended only to mean that there would be no verification on the construction project. Verification should occur in other forms by random audits of records or random testing of samples. If it is felt that certification of a product or material does not have to be verified we suggest that the product or material is not important enough to require a certification at all. Simply rely on the general contract requirements that make the contractor responsible to provide suitable materials or products.

Recommended Changes to the Plans, Specifications and Contract Documents

We recommend that the DOT-14 be used as the control for the entire documentation of certifications for a project. It should be created for a project and included in the contract documents before the project is announced for bidding. This will provide a basis for the contractor to plan and control handling of certifications. The field engineer will have the same basis for controlling the acceptance of certifications and reporting to the Certification Engineer. The Certification Engineer will use it as a basis for certifying to FHWA that all products meet specifications. It will have to be revised to reflect any new methods of certification for each product which the Department may select upon implementation of this project's recommendations.

Specifications must be adopted to create and enforce the Umbrella Certificate. Suggested language is included in Task 9.

Manufacturer's Certificate Process

We propose that this process remain essentially the same as currently written in Department manuals and specification books. Recommended changes include specifying and enforcing the requirement that the contractor provide the certification before being paid for the product installed. This would permit a contractor to install a product before the certification is approved by the field engineer, with the risk of removing or remedying unacceptable products. We also recommend the contractor provide two copies of the certification so that one copy can be used to authorize payment and one copy can be sent directly to the Certification Engineer. To save time, the field engineer should note on the certification that it has been checked to see that it has the necessary information, that it represents the products to be installed, and that the products meet the specification. The Department will have to provide copies of the current specification references for all field staff for this to be workable. The cost of investing in these references should be offset by recognizing and solving problems at a time when they can be corrected much easier.

A process flow diagram of the revised Manufacturer's Certification process is shown in Figure 5.

We believe these changes will result in considerable time savings for the contractor, the field staff and the Certification Engineer. Unless the contractor is not required to actually provide a certificate at the end of a project it seems logical that it will take much less time to provide it in an organized manner when the product is brought to the site. From interviews it appears that to check the certification in the field at the correct time takes very little time for a field engineer, on the order of five minutes for a few pieces of product, whereas to find a certification and the product at a later time takes hours. Further, if the certification is not compared to the product at the time of installation the likely result is acceptance of a certification without checking to see that it represents the product that was installed. Likewise, the Certification Engineer will spend only a few minutes on a certification properly provided but will spend an hour or more requesting missing ones or ones that are incorrect.

The problem, of course, is that the time needed to provide and check a certification comes when there are multiple demands on the contractor and the field engineer. It will be necessary to make the process a priority and to make it as easy as possible. We believe the recommended implementation of the changes will result in an understanding of the value of doing it at the right time and make it easy to do. There is also a feeling among some staff that "paperwork" can be left to the winter when there is nothing else to do, or at least activities are not so pressing. That attitude must be changed through education and training.

We recommend enforcing the existing requirement that the contractor not be paid until the certification is accepted as a way to force accountability upon contractors and field engineers. A contractor can not complain about lack of payment if they have not provided a certification. A problem expressed by the contractors is that they provided the certifications but the certifications were mishandled by the field engineers. Possibly that is why the current practice is to pay the contractors without regard to status of certifications. However, the Department has to insist that proper handling of certifications be given high priority by Department engineers and hold them accountable for poor performance.

Figure 5. New Basic Process

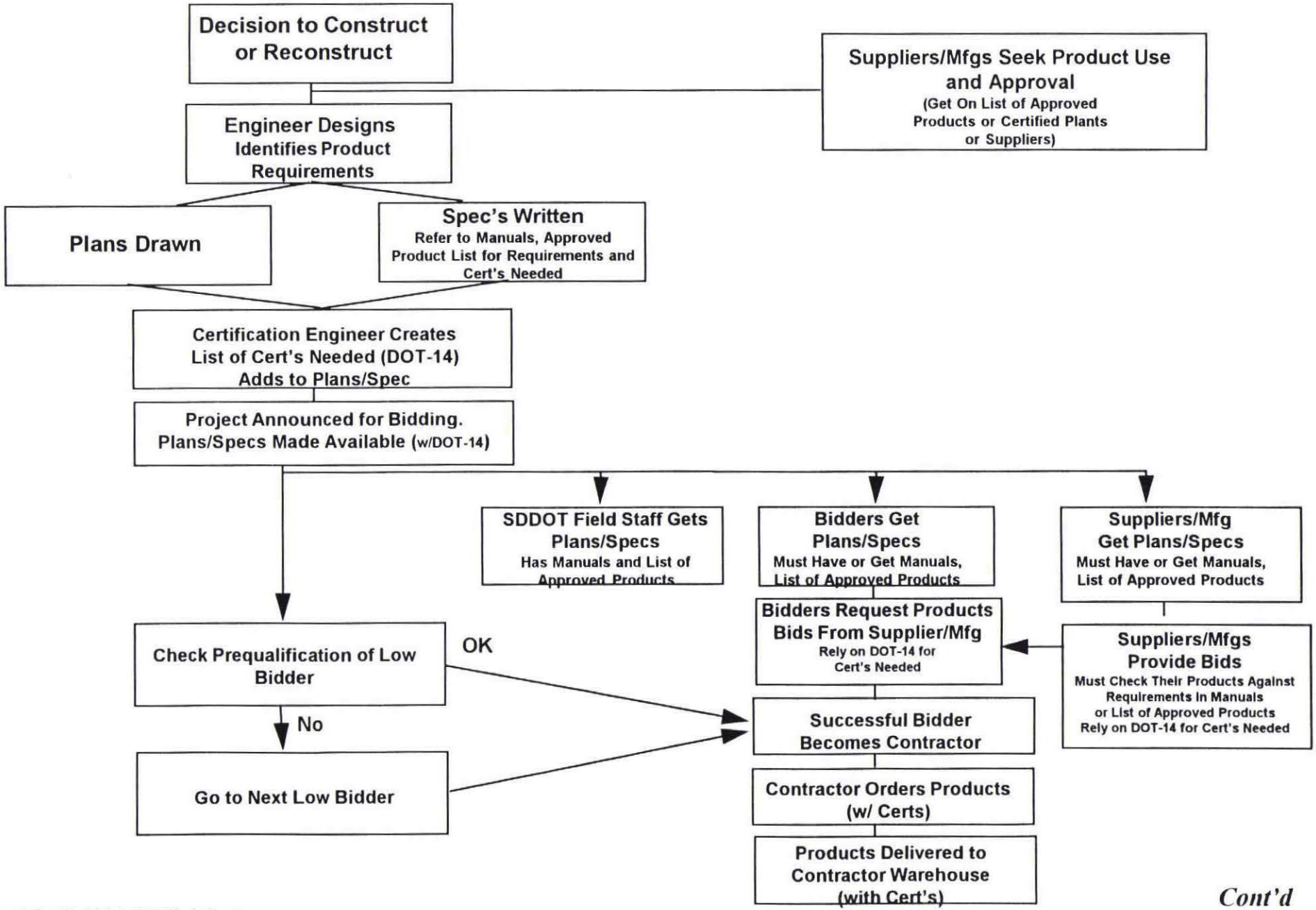

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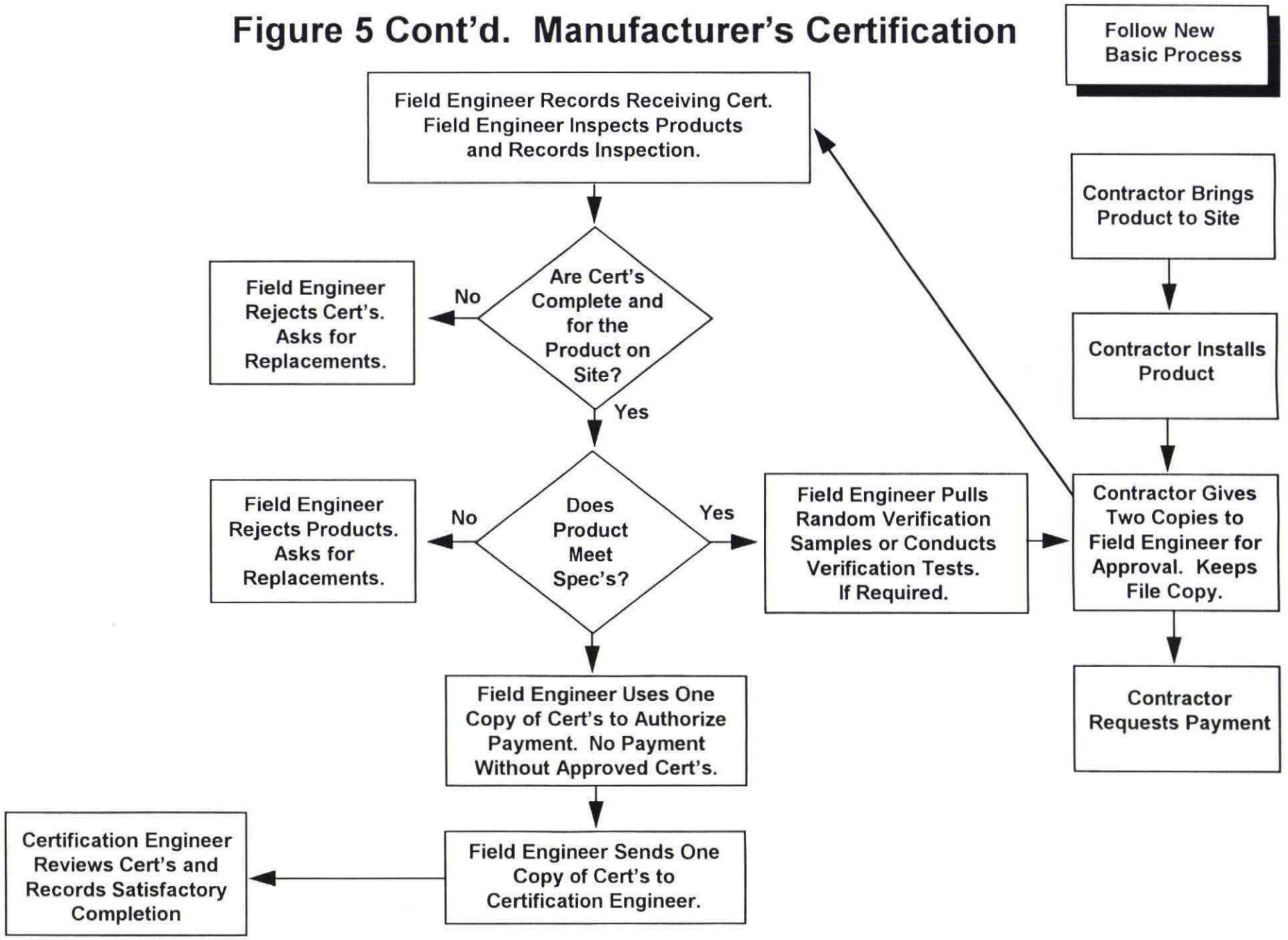
Figure 5 Cont'd. Manufacturer's Certification



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Eliminating the backlog of certifications at the end of the project will speed project closeout.

Approved Products List Process

This process was recently studied as a part of SDDOT Product Evaluation (SD95-02). We recommend that it be continued with possible modifications to adopt the three suggested verification methods.

In Table 4 we have indicated that we question the use of Random Sampling and Testing as a verification method for a product on the Approved Products list. It is our opinion that a product which can not be adequately tracked after prior approval for quality control by the producer should not be accepted for the Approved Products List. There should be an identification on the product which confirms it is what was approved. If identification is not possible, the product should be accepted by random sampling and testing rather than being on the approved products list.

Certified Plant Process

This process has good applications and we recommend it be continued.

One change which can be considered is the adoption of acceptance based on statistical process control for documentation of product suitability. If a plant has adequate testing to develop a statistical process control chart and uses the chart for controlling manufacture of the product it would be possible to accept any material shipped during the periods when the manufacturing is in "control" without having to pay specific attention to lot numbers. Documentation would consist of the process control chart. Verification could include assurance testing at the plant by Department staff or by an independent laboratory.

In the future, as more plants become ISO 9000 certified, or have a similar quality management documentation, other means of acceptance can be considered.

Umbrella Certification Process

The umbrella form of certification is generally described in Task 6, along with an analysis of its use and its advantages.

A process flow chart for the Umbrella certification process is shown in Figure 3. Refer to Task 6.

In operation, the contractor will compile the necessary certifications for the products being used in the project and keep those in their project file for a minimum amount of time, suggested as five years. The contractor will complete an Umbrella certification form (titled DOT-14U for the purposes of this study) listing the products by description and identifying lot numbers and listing the certifications which are on

file for those products. Those products (from a single lot) and certifications may be used on any number of projects but copies of the certification must be kept in each project file.

The DOT-14U form can be a three-part, carbonless form, a single sheet form reproduced to create two copies to give to the Department's field engineer, or an electronic version. An example of this form is shown as Figure 6, DOT-14U Umbrella Certification.

During the project the contractor does not have to provide the Umbrella certification form before installing the products. However, they must provide it before they request payment.

The field engineer inspects the work to evaluate if it has been constructed properly and makes a record of the visual inspection, but does not have to check the products used against the material certificates. One of the two copies of the Umbrella certification form is sent to the Certification Engineer to be recorded as received. The other copy is used to authorize payment for the constructed work.

Again we recommend requiring the certification document before payment is authorized, as a means of enforcing the process.

Verification of this certification process is based on an audit of a contractor's project files and the constructed project by the Certification Engineer. The projects to be audited should be chosen by a random-number selection of projects constructed during a 12-month period to be most fair and effective. We suggest auditing 5 percent of projects that have Umbrella certificates, or a minimum of 3, a year.

The Certification Engineer would give a contractor a 48-hour notice (it could be 24 hours) and visit the contractor's office to audit the files for the proper certifications. The certifications listed on the Umbrella certification forms will have been checked by the Certification Engineer during the project to see that they are adequate for what was needed on the project. Thus, the audit will be to compare the certifications in the contractor's files to the forms.

Figure 6. DOT-14U Umbrella Certification of System Products and Materials

County:_____ PCEMS No._____

Project Number:_____ Location: Sta_____to_____

Bid Item Number:_____ System Type:_____

_____

(Name of Contractor or Subcontractor) (Address) (City, State, Zip Code)

has provided the following materials and products to construct the referenced system on this project:

Plan Item	Description (Lot number, etc.)	Quantity This Report	Unit (m, m^2, etc.)	Applicable Specification	Manufacturer	Manufacturer's Certification Number

I hereby certify that the above listed items of materials do meet the requirements as set forth in the plans and/or specifications and that the appropriate manufacturer's certifications will be retained in our project file for a period of 5 years from completion of this project.

By: _____ Title: _____

(Name typed or Printed) (Authorized to sign for company)

_____ Date: _____

(Signature)

Note: Contractor must maintain one copy in project file and submit two copies to the Area Engineer before payment will be made.

If the audit shows the files to be complete the next step is to visit the project and spot-check the products and project records to see if the products listed on the forms are in place on the project. If the files are incomplete the contractor will have to acquire and provide the correct certifications before moving on to the field audit. If the certifications don't match the products in the field the contractor will have to acquire the correct certifications or replace the products. If the products don't meet the specifications they should be replaced with correct products and correct certifications. Materials or products which cannot be identified or otherwise verified in the field should not be included in this certification process.

If the contractor "fails" the file or field part of the audit a penalty will be enforced. We recommend that the penalty for incomplete files or the wrong certifications for the products in the field be disqualification from bidding for a period of time. The time period could be variable depending on the severity of the situation. Minimums of 6 months for the first failure and 12 months for the second are suggested. The penalty for having incorrect products should be more severe. We suggest minimums of one year for the first failing project and two years for a second failure. Greater time periods would be justified for extensive failures. A fine should be assessed which will compensate the Department for costs of the audit beyond the cost of a passing audit. The disqualification should be registered in the pre-qualification file for the contractor so it is available if the contractor bids during the restricted period.

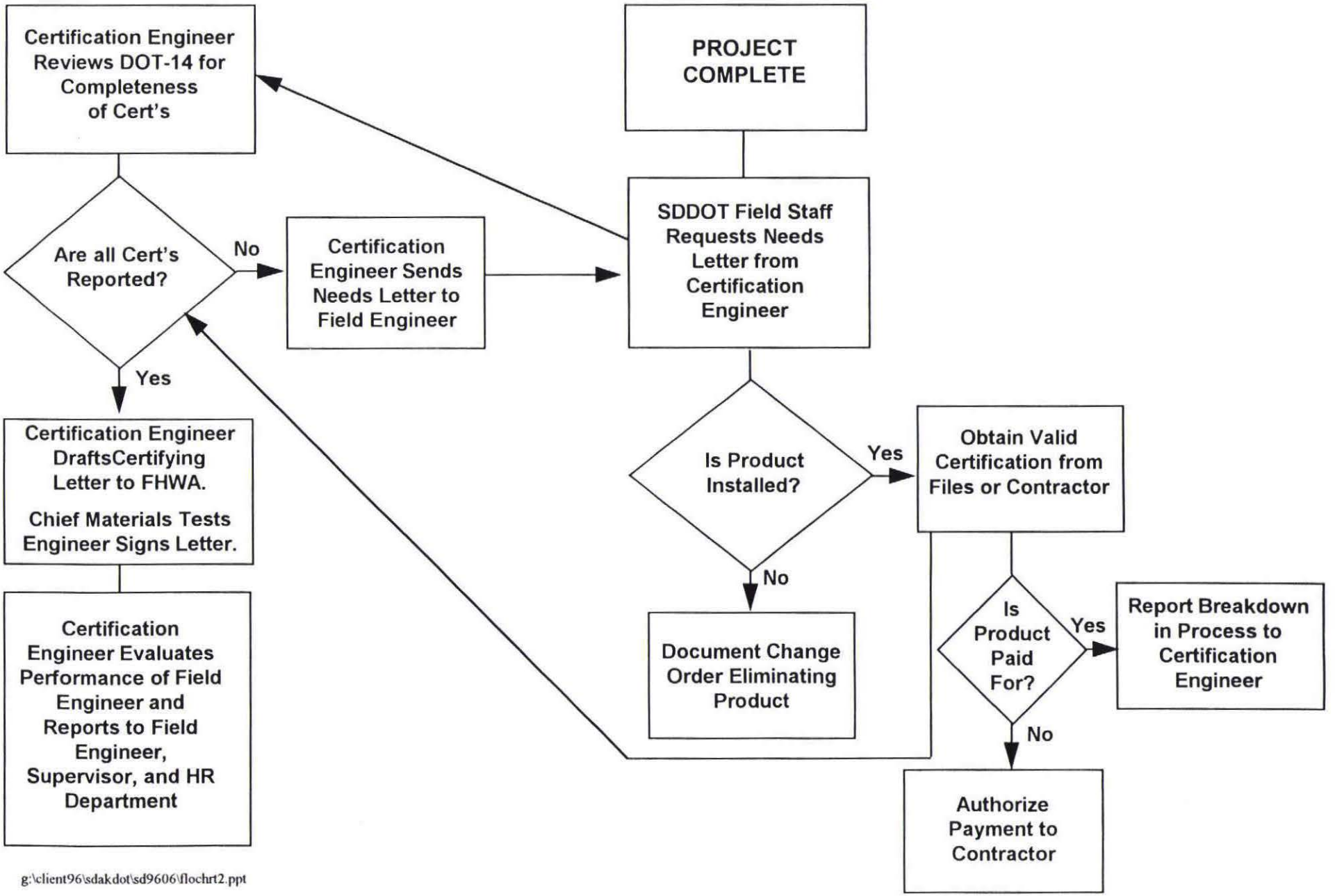
Further, if a contractor fails either part of the audit at least two more of their projects should be audited.

Preparation for "Certifying Letter"

It is recommended that a copy of each certification on a project be sent to the Certification Engineer by the field engineer so the Certification Engineer can document that the certification processes are happening in accordance with the specifications (as is currently being done). See Figure 7, New Project Closeout.

The field engineer would notify the Certification Engineer when the project is completed. The Certification Engineer would look at the DOT-14 form for the project to see if all the needed certifications have been sent in. If not, the missing ones would be requested from the field engineer. We understand that the current process requires the field engineer to send a "Needs Letter" to the Certification Engineer to see what is not turned in. We recommend changing that process slightly, as noted above. With good implementation of the new processes the last certifications should be turned in concurrently with completion of the construction.

Figure 7. New Project Closeout



If there are missing certifications (there shouldn't be) the field engineer should obtain the missing certifications from the contractor, evaluate them for adequacy and check to see if the contractor has been paid for the products. If the certifications and products meet the specifications and the contractor has not been paid payment should be authorized. If the contractor has been paid the field engineer should advise the Certification Engineer of the breakdown of that part of the process.

Evaluating Certification Processes

At the end of a project the Certification Engineer should evaluate the performance of the field engineer related to the certifications processes. The evaluation should be sent to the field engineer, the field engineer's supervisor and to the Human Resources file for the field engineer. The letter should become a part of the field engineer's performance evaluation. Poor performance should result in additional training, at least, and other disciplinary action in the event of repeated poor performance.
The Certification Engineer should also evaluate the performance of the total certification system yearly for opportunities to improve various parts of the processes.

Automation Possibilities

The entire certification processes are suitable for automation. We understand the DOT-14 is generated by computer now so it could be made available to the contractors electronically. They could then keep their control system electronically and provide certifications to the field engineer electronically (if the field engineer has the capability to receive them). The field engineer could then easily take the necessary actions on the project before sending the copies to the Certification Engineer and to authorize payment. The status of each certification could be tracked on the DOT-14 form kept by the Certification Engineer, available to the field engineer and the contractor as "read only."

The cost of electronic "hardware" for a field engineer to handle this and other applications (field diaries, authorization for payments, quantities, etc.) would be on the order of $5,000. One rule of thumb for the cost of training is that it equals the cost of the hardware. The cost of associated special software is harder to estimate but could be on the order of $2,500 per field engineer for 100 field engineers. Thus, the cost of equipping a field engineer would be on the order of $12,500.

If field engineers are paid an average of $15.00 per hour and have a total overhead burden of 100 per cent of salary, their time is worth $30.00 per hour. At that rate it would take time savings of 417 hours to pay for the investment in automation. At a savings rate of 4 hours per week it would take 2 years to recover the investment.

We believe 4 hours per week is very reasonable for all the activities the field engineer is involved in. Time is saved not only because paperwork is handled quicker but also because fewer mistakes are made, which eliminates rework that is particularly time consuming. An example is the difference

between spending one-half hour to do a certification according to the process and spending one to two days to do it later. Further, the efficiencies are magnified by the savings of time for other staff in the various processes.

This task is completed. New processes and revisions to existing processes are proposed to be more effective, efficient and acceptable to the people who must execute the processes.

Task 9

> *"Recommend specifications, policies or procedures which will allow implementation of a modified certification process."*

This task will provide information needed to facilitate the actual implementation of the recommendations. Included are:

- steps for implementation
- proposed revisions to requirements contained in the specification language
- proposed policy revisions
- draft letter to FHWA for approval of changes
- outline of communications to engineers, contractors, suppliers
- outline of training for engineers, contractors, suppliers
- steps in automation
- follow-up and measurements

Steps for Implementation

The following are steps we believe are required for the successful implementation of these new certification procedures. We have suggested a person to be responsible for accomplishing the steps and a timetable.

1. Senior management must accept the recommendations, adopt the needed policies and authorize the expenditure of funds for training and automation (if automation is to be adopted). This should be the responsibility of the Secretary of Transportation and should be done by April 1, 1998.

2. Schedule communications and training at upcoming meetings. This should be the responsibility of the Materials and Surfacing Engineer and be accomplished by September 15, 1998.

3. The analysis of automation of these processes for the field engineers should be started immediately after the senior management decision to accept the recommendations. It is

recommended that this be the responsibility of the Director, Division of Operations, and be accomplished by January 1, 1999.

4. Engineers in design and construction must work together to decide how the Department should accept each type of material or product. Methods for this evaluation are included in Tasks 7 and 8. Materials and products should be assigned to the array of certification and verification methods of Task 4. This should be the responsibility of the Materials and Surfacing Engineer and completed by December 1, 1998.

5. The Department must seek approval of the changes from FHWA. It is suggested that this be the responsibility of the Materials and Surfacing Engineer and that a letter be sent to FHWA by January 15, 1999.

6. The requirements listed in the DOT-14 form must be revised to reflect the new assignment of materials and products to methods of certification and verification. There may also be changes which could make the electronic version more amenable to transfer among field engineers and contractors. It is recommended that this be the responsibility of the Certification Engineer and be accomplished by January 1, 1999.

7. The Manuals and Standard Specifications must be revised, or the changes put into Special Provisions until the manuals and book can be revised. This should be the responsibility of the Materials and Surfacing Engineer and accomplished by January 1, 1999.

8. Implement communications and training. Create training materials and manuals for ongoing use. We suggest this be the responsibility of the Materials and Surfacing Engineer and the training be accomplished by April 1, 1999.

Specifications Revisions

We recommend the specifications for using a manufacturer's certification be revised to allow installation of the material or product before two copies of the certification are provided but that payment not be allowed until the certification is provided and checked against the material or product. Also, the copies of the certifications would be retained in the Certification Engineer's office rather than the project file. This requires changes in the language of the Standard Specifications, Section 6.3 and the Materials Manual, Section 5.10. We suggest the following revisions for the Standard Specifications:

> "Materials will be inspected, tested and approved for use by the Engineer, prior to payment for the work. The Contractor shall furnish two copies of certifications for all materials designated in the Contract or the DOT-14 Summary of Requirements for Samples and Tests. ..."

Revisions for the Materials Manual could read as:

> "Certification is the process by which... ...Materials installed without the required two copies of the certificates shall not be included for payment before receipt of certification or satisfactory test results."
>
> "Each certificate shall be checked as received... ...shall be dated and signed by the individual making the inspection and one copy immediately forwarded to the Certification Engineer at the Central Laboratory.
>
> "The Certification Engineer will assign a number, review and approve or reject the certification. A satisfactory certification will be recorded on the DOT-14 control for the project. An unsatisfactory certification will be returned with a request for corrections.
>
> "The second copy of the certification will be submitted with the contractor's request for payment as authorization to pay for the material or product."

For Section 5.11 CERTIFIED FABRICATORS, MILLS AND PLANTS of the Materials Manual we recommend a paragraph be inserted as the second paragraph in Operational Procedure. to advise the Area Engineer of the reporting of these materials on the project. Suggested language is:

> "When materials are installed on the project from a certified fabricator, mill or plant the Area Engineer will have it visually inspected to confirm its origin and sampled, if required. This inspection will be reported immediately to the Certification Engineer for review and recording on the DOT-14 of the project. The inspection will also be reported to the Area Engineer as authorization to include the material or product in the next Construction Payment Estimate."

A paragraph similar to the above paragraph should be included in Section 5.12 of the Materials Manual to clarify the recording of installation of materials from the Approved Products List.

A new section will be required in the Materials Manual for acceptance by Umbrella Certification. We suggest the following:

"5.14 UMBRELLA CERTIFICATIONS:

Definition.

An umbrella certification is a single document that a contractor provides which certifies that the contractor has in their project files the necessary manufacturer's certificates to cover a number of products or materials that go together to make up a system that accomplishes a specific purpose on a highway construction project. These systems include:

Guard Rails
Traffic Signals
Lighting
Chain Link Fencing
Buildings, Rest Areas
Signing and Delineation

This certification will be provided on Form DOT-14U.

Operational Procedure

Systems to be certified by umbrella certification will be noted on the Plans in the Estimate of Quantities list of Bid Item Numbers. Products and materials included in the systems will be detailed on the plan sheets.

The contractor will provide two copies of Form DOT-14U listing the products and materials included in the system and the required manufacturer's certifications, certified fabricators, mills and plants, or approved products to the Area Engineer.

The Area Engineer will have the system visually observed for proper construction, quantities, and materials that can be visually identified. The observation will be recorded by the individual making the inspection on the Visual Inspection Form. Any required random samples, for verification of certifications, will be obtained. It will not be necessary to confirm that the certifications are as required.

A copy of the signed and dated Umbrella Certificate and Visual Inspection Form will be immediately forwarded to the Certifications Engineer for cursory review and recording on the DOT-14 control form for the project. If the certificate is not satisfactory at the cursory review the Certification Engineer will request additional information from the Area Engineer.

A second copy of the signed and dated Umbrella Certificate will be immediately forwarded to the Area Engineer as authorization to pay for the material or product installed in the next Construction Payment Estimate.

Verification of Umbrella Certifications

Umbrella certifications will be verified by random testing where indicated on the DOT-14 and by random audits of contractor's files and field projects. The audits will be selected by compiling a list of all projects with umbrella certifications in the 12 months from May 1 to April 30, and selecting 5 percent of the projects, or a minimum of 3 projects, by a random-numbers process.

The Certifications Engineer will make the selection and audits. After a project is selected the Contractor will be notified and their project files audited within 48 hours. The office portion of the audit will review the manufacturer's certificates in the files to confirm that they match the list provided on Form DOT-14U for the systems audited and that the list is complete.

Upon successful completion of the office portion of the audit the Certifications Engineer and the Contractor will inspect the constructed system and the Department field documentation to verify that the products and materials in the field are as represented by the certifications.

If a contractor's files are not complete or correct they will be required to remedy the problems before the field audit. If more than 5 percent of the certifications are not correct the contractor will "fail" the audit and such failure will be recorded in the prequalification record of the contractor. The first failure will result in disbarment from bidding for a period of 6 months from the date of the audit. A second failure will result in disbarment for 12 months.

If the constructed system does not contain the products or materials represented by the umbrella certification the contractor will be required to correct the certifications and replace any products or materials that do not meet the relevant specifications.

If more than 5 percent of the materials or products are not as represented by the umbrella certification the contractor will have failed the field audit. If the materials or products in place meet the relevant specifications the failure will be penalized the same as a failure of the office audit. If the materials or products in place fail to meet the specifications the failure will be penalized with disbarment from bidding for 12 months for the first failure and 24 months for any subsequent failure.

The Standard Specifications Section 2.1 PREQUALIFICATION OF BIDDERS should be revised to create a prequalification of bidders for projects less than $100,000. It may be possible to simply reduce the existing dollar limit to $25,000 or another appropriate limit. Or, a separate category could be created for tracking Umbrella certification performance. For the latter approach the language could be:

"2.1.1 Umbrella Certifications Prequalifications - Prospective bidders must not have a current disbarment in effect as a result of failure of an audit(s) of their files or construction of a system certified under the Umbrella Certification procedure."

Policy Revisions

It is our impression that there is an unwritten policy, at least among regions, that certifications do not have high priority during the construction season. While this may be appropriate relative to other activities there is a significant cost associated with letting the certifications slide to the end of the season. Thus, we recommend that the priority of the processes be explained convincingly so the written procedures are followed. This may require specific directives from senior management for complete agreement.

There also appears to be an unwritten policy that contractors will be allowed to install materials and products and will be paid for those installed materials and products without the certifications. We recommend that senior management express and implement a change that requires the certifications be provided as a prerequisite to payment. As noted earlier, this is a strong incentive to conduct the processes as designed and thus, in the most efficient manner.

Draft Letter to FHWA

A draft letter to FHWA requesting their approval of the new processes is included in Appendix C, FHWA Letter. This letter cites relevant laws and regulations, generally describes the changes and how they continue to meet the laws and regulations, and compares the changes to what has been accepted by FHWA in other states.

Outline of Recommended Communications About Changes

Communicating the new processes to all the people affected will be important to successful implementation. We suggest that the communications follow an outline, created as potential overhead transparencies in Appendix D, Communications Outline, to accomplish a message which will be convincing.

For acceptance of new processes it is necessary that people agree with the philosophy of certifications. Thus, we recommend that the purpose of the certification process be identified and reaffirmed. The

purpose is well stated in the Federal-Aid Highway Program Manual as "to assure, with reasonable risks, the material meets the specifications."

The processes have value to all parties involved in the construction project. Ultimately the highway user is benefited because they are able to use a safe, efficient highway. The Department is able to carry out their mission of providing that safe, efficient transportation system. Design engineers can design a project, specify materials that meet the needs of that design and have confidence that the project will be built as intended. Construction engineers have a basis for accepting products and materials knowing that they are fulfilling the intent of the design. Contractors and suppliers have a basis for bidding that is the same for all bidders, which will be enforced to maintain fair competition.

People will also have to agree with the goals of the changes. It is recommended that this study be recapped to identify the goals, how the problem was studied, document the findings and justify the recommendations. The policy decisions of the senior management will need to be communicated clearly so that people know that there will be no unwritten policies that allow deviations from the procedures. Contractors will worry about not getting paid because a Department person is not processing the certifications. It will be important to convince the contractors and Department staff that both groups will be held accountable for carrying out their responsibilities promptly.

The changes should then be briefly discussed. Everyone needs to know the general nature of the total processes so they can understand how their actions fit into the total processes.

It should be emphasized that everyone needs to have training if they will be involved in parts of the process. The training is crucial to the successful implementation of the changes and to improve the processes. The time a person spends in training will be quickly recovered on the first project having the new specifications.

Finally, the schedule for implementation should be communicated. This should include the schedule of opportunities for training.

Training Outline

Training will be a more detailed communication of the revised certification processes. It should include oral and visual presentations of the information and short exercises in carrying out the processes to reinforce the communication. An outline for training is included as potential overhead transparencies, in Appendix E, Training Outline.

The training will include the purposes, goals and recap of this study given in the communications outline. More detailed information about the processes can be given through the process flow diagrams and copies of revised and new forms. The array chart of certification methods and verification methods

for products and materials will also be presented. The training should cover all forms of certifications, even if there are no changes, because it was apparent from the interviews that not all people understood the requirements of the various processes.

The training should establish the process of evaluating the performance of the people and the processes so that they can be further improved.

Training should provide written materials that will serve as a reminder and refresher on the processes.

Depending on the schedule for automation of the processes, automation may also be part of the training.

Follow-up and Improvements

Implementing the proposed changes will likely uncover some parts of the processes that do not work as well as they could. It will be valuable to track the time required to execute the processes, the number of times the processes are not followed, and why. The Certification Engineer will be in the best position to direct these studies.

It is suggested that the first issue to be tracked be the impact on payment to the contractors of having the certifications as a prerequisite to payment. Reasons for delays should be documented, not left to anecdotal recollections at a later time.

We believe this task is complete. There may be other references to certifications in Manuals, the Standard Specifications or Special Provisions that require revisions to match the proposed revisions. Department staff familiar with the language of the various parts of the construction documents should be alert for these conflicts.

Task 10

> *"Submit a final report summarizing relevant literature, research methodology, findings and conclusions."*

The final report is a culmination of the research and review of the draft report by the technical panel. It has been completed with the production of this final report.

Task 11

> *"Make an executive presentation to the SDDOT Research Review Board at conclusion of the project."*

The recommendations of the researchers were presented to the SDDOT Research Review Board on August 21, 1997, by the Principal Investigator. The limited time available prevented significant interaction with the Board. This task is complete.

Chapter 4
Findings and Conclusions

The following paragraphs present the significant findings we have obtained during this study that are the basis for the conclusions presented below.

4.1 Significant Findings

- Very few "failures" of the certification system in South Dakota were identified in our interviews of contractors, suppliers and Department staff. A failure of the certification system is defined as the use of a material that did not meet specifications which caused the material to not meet its intended use in the roadway.
- A 1982 study[1] of the problem disclosed many of the same problems expressed by the technical panel and Department staff.
- Published studies[1] and personal experiences document that a certification process that has no verification is not effective in preventing intentional or unintentional use of poor materials.
- All agencies rely on Certifications or on Approved Products Lists.
- A majority of agencies conduct some sort of verification testing.
- Sixty eight percent of the agencies that responded to the survey question on improvements indicate that they have made improvements in the certification process.
- Fifty seven percent of the survey respondents indicate they use some sort of package certification.
- Five out of 33 that responded to the survey question stated that they use warranties in lieu of certifications.
- Suppliers, contractors and Department staff do not have a clear idea of the processes currently required by the Department.
- Suppliers, contractors and Department staff do not have a good picture of the value of certifications to all the parties in the construction process.
- The actual certification practices do not follow the written processes in many cases.
- Many staff and contractors indicated the processes have improved in the last two years.
- Contractors install materials and receive payment for materials placed even if no certificate is available.
- Field staff do not feel empowered to enforce the certificate requirements as proscribed by the Materials Manual.

- The staff time required to handle certifications is minimal if the process is followed, but becomes significant if the process is not followed. Estimates of staff suggest a one-half hour activity done at the right time becomes a one- to two- day activity at the end of the project.
- Secondary issues that are strongly related to certifications include the RECORD OF VISUAL INSPECTION AND FIELD MEASUREMENTS, (DOT-25) forms and the Approved Products List.
- The FHWA Technical Advisory T 5080.11 states "The purpose of a materials acceptance plan is to assure, with reasonable risks, the material meets the specifications."
- The regulatory issues of the Federal Highway Administration (FHWA) are described in 23 CFR. 23 CFR states that the agency must have an established, and FHWA approved, operating procedure that adequately protect the interests of the FHWA, the agency, and the public.
- The State of South Dakota does not have laws which impose any specific rules or requirements regarding acceptance of materials by the Department. The DOT's obligation to the FHWA on federal aid highway projects is to certify that the materials used and the construction complied with the plans and specifications, project by project. The letter that certifies to the FHWA is signed by the Chief Materials Engineer.
- Twenty agencies indicated they accept umbrella certifications while 15 agencies indicated they do not.

4.2 Conclusions

On the basis of the findings reported above we draw the following conclusions about the use of certifications in the construction and maintenance of South Dakota's highways.

- This study indicates that many things are being done successfully in the certification system of the Department. Still, there are opportunities to improve the certification processes and how they are used.

- The written procedures for certifying various materials are generally adequate to protect against poor materials being used in construction. These procedures compare favorably with many of the states surveyed, particularly those in your geographic area and those with similar traffic volumes and loads.

- In practice the procedures are not followed in all cases. This is likely because the people involved do not feel the effort is warranted. The reasons given include the ideas that there are duplications of certifying and testing of some materials, no verification of certifications so there is no activity which encourages a supplier or contractor to be

honest if they have an inclination not to be (we heard no "accusations" that contractors or suppliers have tried to be dishonest), no penalties for contractors who do not provide the certifications before the materials are used in the projects, lack of time during the construction so activities with more perceived value are done instead.

- Umbrella certifications are an acceptable means of handling systems under a single certification. There are several areas that are considered to be candidates for an umbrella certification:

    - Guard rail systems,
    - Traffic signal systems,
    - Lighting systems, and
    - Fencing systems.

The benefit of an umbrella certificate is labor savings for the Department. It will not significantly reduce the labor requirements of contractors or vendors but will simplify compliance with the requirements. Inspection is still a necessary component of a successful umbrella certification system.

- New certification processes must balance the cost of the process to suppliers, contractors and the Department against the risk and cost of damage in the event of a failure of the certification process. Thus, several certification processes with differing levels of detail for evaluating the material and for verifying the certifications is appropriate.
- The legal and regulatory requirements are not a hindrance to changes since the requirements are left up to the Department to establish, subject to FHWA approval.

Chapter 5
Implementation Recommendations

This study has provided a valuable analysis of the use of certifications and how they can be improved. The value of the study will not be realized until the conclusions are implemented. In the following paragraphs we recommend the activities we believe will be appropriate for implementing the conclusions and realizing the benefits of improved processes. The activities include changes in policies, specifications, and procedures. Training for the various people involved will be important. Finally, we recommend additional studies the Department should conduct to monitor the benefits and look for additional ways to improve.

We recommend the Department build on the good processes in place, with changes to reflect the lack of failures of the existing processes. The revised processes should be communicated to the entire industry to gain acceptance of the revisions and to reestablish the need and importance of certifications. Suppliers, contractors and Department staff should be trained in the revised processes so the processes are followed properly and function as intended because the revised processes have a smaller "safety factor" than the existing written processes in that there is less redundancy, less testing and more reliance on supplier or contractor information. The revised processes should be monitored to see that they are accomplishing their intended purposes and to find ways to further improve them.

1. *Top Management Support:*
   Implementation must begin with a top management decision to support a revised, renewed emphasis on certifications and to accept the limited risks involved in reducing certification requirements. The support requires making policy changes, communicating them strongly and regularly, and allocating the financial resources to provide recommended equipment and training.

   Policy changes are needed to support the new procedures. Top management should not adopt new procedures if they are not willing to enforce policy changes. A critical example is the current policy of allowing the contractor to install materials and be paid for them before certifications are provided and approved, even though the written procedures do not allow installation, much less payment, without certifications. The new processes go part way to accommodate existing practice by requiring certifications before payment, giving the contractor and field engineer a little more time to complete their parts of the process. It is our opinion that having such a serious "deadline" will cause the processes to be followed. Other similar policy changes are necessary for success of the processes.

   Top management must put in place the policies and procedures that make following the new procedures a part of the appropriate staff job descriptions. This fits four of the five "key measurement areas" the Department has recently initiated - cost, timeliness, rework, customer

satisfaction. The conduct of those procedures must be measured and evaluated regularly to emphasize the value of the certification process. It is an accepted maxim "that which is measured improves." The importance must be reiterated periodically by all management levels so the procedures do not fall into ineffective activities.

The recommended revisions will reduce the current written requirements for testing materials. This implies an increased risk of poor materials being incorporated into roadway construction. If that does happen, there will be costs associated with corrections and possible liability for damages to the traveling public. However, it is our opinion that the risks are minimal and the reduced costs associated with the recommended changes will exceed the possible increased costs if failures would occur. This opinion assumes that the recommended changes are fully implemented, particularly including the certification verifications. The risks may actually be reduced from the way the procedures are currently implemented, since the current written procedures are not being followed completely and having procedures and not following them creates more Department liability risks than not having procedures.

To be successful the revisions will take an investment in time and money. New computer equipment is suggested to save time. Top management must direct mid-level management to allocate the necessary staff time for training and conducting the revised procedures at the correct time in the process. The findings suggest that the estimated investment will pay back in time savings within one, or possibly two, construction seasons.

2. *Umbrella Certifications:*

We recommend a new "umbrella" certification process that would require contractors to maintain a complete record of sources and individual component certificates used for system construction and issue an "Umbrella Certificate" that lists the system components and the certificates provided to the contractor for those materials.

This will shift responsibility for documenting material acceptance to the contractor. The Department would have the right to inspect the contractor's records on a 48-hour notice. The Department would continue to be responsible for inspecting the system construction and the proper material use. We strongly advise that random testing be conducted of high-strength bolts, rails, cables and other structural components. Where possible, immediate field tests should be devised. An enforced sampling and testing policy not only will give the contractors more incentive to meet the specifications but will also improve the Department staff morale.

There are several areas that could be considered candidates for umbrella certification:

- Guard rail systems,
- Traffic signal systems,

- Lighting systems,
- Chain link fencing,
- Buildings, rest area, and
- Signage and delineation.

3. To replace specific certifications which the Department feels are not really necessary, we recommend a "contract certification" to be signed by individuals of the contracting firm stating that the firm has installed materials and products that meet the requirements of the specifications.

4. *Tiers:*
The Department's current acceptance methods should be continued but with some redefinition based on how a method is verified. Several methods are available to accept materials supplied to projects. We recommend the following five methods.

   A. Manufacturer Certificate
   B. Approved Product List
   C. Certified Plant
   D. Certified Supplier
   E. Umbrella Certification

These methods should be subdivided by four verification levels. The verification level should be based on the importance of the material to the overall performance of the project, and to health and safety concerns. Four levels of material verification provided under any of the above methods are recommended as follows.

   1. Random Sampling and Testing
   2. Visual Inspection (DOT-25)
   3. Random Audit
   4. No Verification

This results in 20 possible certification processes. We do not anticipate the Department needing all of those possibilities. Further, several of them are very similar in nature and with a DOT-14 list to keep the processes identified with the materials and uses, and with training of the people, the complexity should be very manageable and the flexibility will be beneficial.

5. *Communicate the New Process to the Industry:*
The Department's new requirements must be clearly communicated to the industry before the processes are made a part of projects.

Presentations should be given to various segments of the industry, including the Association of General Contractors (AGC), suppliers and consulting engineers. The presentation should be about one-half hour long and should emphasize the Department's commitment, the processes, policy changes and how it will impact various industry segments. This must be followed by specific training.

6. *Training*:

Department staff, consulting engineers, contractors and vendors must be adequately trained in the new processes. All participants should understand the general certification procedures so they know how their activities contribute to the total system. They may not need to know the details of activities in which details they are not involved. The process details must be taught to those who have to manage and execute the processes.

This report includes recommended training materials and visual aids that will facilitate learning and understanding the revised procedures. Flowcharts document and demonstrate the processes. Written text also describes the processes and gives the rationale for the revised processes. Training activities will require two to three hours of presentation, discussion and working through examples.

We recommend the Certification Engineer be responsible for this training. It should be completed before new processes are included in projects.

7. *Contractor Payments:*

We recommend that materials furnished and installed not be paid for until the Department has received the appropriate certificate for the materials provided. Alternatively, the withholding could be some percentage of the payment.

8. *Project Engineer Documentation:*

For selected materials and uses, we recommend the Department continue with a formal process of verifying materials acceptance with the Record of Visual Inspection and Field Measurements (DOT-25). For items that currently require a certificate or are on the Approved Products List, we recommend a form be developed based on the DOT-14, that the field staff can use to indicate the material was furnished, met specifications, had a certificate or was on the APL, and has room for a short comment. A similar process can be used for Umbrella Certifications.

9. *Modify the Materials Manual and Specifications as necessary and seek FHWA Approval:*

The Department, through the Chief Engineer's office, should revise the specifications and plans which state the requirements where necessary to implement the changes. This should be planned for a date after the necessary training has occurred and the equipment acquired. We recommend beginning with projects starting after June 1, 1999.

Specification changes we recommend for improving the certification processes are in the body of the report (Task 9).

The Chief Engineer should submit the revised certification program to the FHWA for their review and approval. This will be required before the changes can be used in new projects. This action will accomplish the necessary legal requirements for the revisions. We recommend this be done in January 1999.

23 CFR requires that FHWA review and approve the certification processes of the states for federal funding eligibility. Once the processes are approved, the states must be able to show that they are following the processes during an FHWA audit. The recommendations for changes are generally similar to what is being done in other states so we expect that approval will be relatively simple.

10. *Automation:*

We recommend that the Department pursue its automation goal to reduce future costs. The DOT-14 forms should be integrated into the Department's software that enables the forms to be generated from the plans and materials lists, and be integrated with the construction measurement and payment systems. Field staff should have access to computers that are, or can be, linked to the central database for the purpose of entering material tracking and testing information and to query the status of the materials tracking and testing. The system should be capable of identifying the method specified for material acceptance such as certificate, Approved Product List, etc., when and where the certificates were delivered, when the materials were inspected for certificate conformance, and when the certificate was approved.

11. *Monitor the Process:*

We recommend that the Certification Engineer continue to be responsible for monitoring the new processes. Monitoring will provide the data necessary to identify areas where the process is not being followed or is not working, and will provide a basis for future system improvements.

12. *Accountability:*

People must be held accountable for their responsibilities in a clear, definite manner. The execution of their parts of the processes should be measured and regularly evaluated.

For Department staff this would be part of their performance reviews. Contractors could be barred from bidding for certain lengths of time. Vendors could lose their position on Approved Product List, etc. At a minimum, all should have additional formal training if performance is not acceptable.

References

1. National Cooperative Highway Research Program Synthesis of Highway Practice 102, Material Certification and Material Certification Effectiveness, Transportation Research Board National Research Council, Washington, D.C., November 1983.

2. Synthesis 212, Performance-Related Specifications for Highway Construction and Rehabilitation, Transportation Research Board, National Research Council, Washington, D.C., 1995.

3. Transportation Research Board Record No. 1491, Comparison of End Result and Method Specifications for Managing Quality, 1995.

Appendix A

Materials or Processes that Need to be Certified, be on the Approved Products List, and/or Documented by DOT-25

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Asphalt Construction								
Asphalt Concrete Composite	1.1.A	yes			yes			
rock, sand, filler	1.1.B				yes			
asphalt cement	1.1.C	yes			yes			
measurement	1.1.G						yes[1]	
Asphalt Surface Treatment								
Asphalt, Liquid	1.2.C	yes			yes			
Dust Oil	1.2.D	yes			yes			
Subbase, Base, and Cushion								
General Notes	2						yes[2]	
measurement	2.1.E						yes[3]	
Asphalt Treated Subbase								
Asphalt	2.2.C	yes			yes			
measurement	2.2.G						yes[4]	
Misc. Granular Fill								
gabion fill	3.6.A						yes[5]	
riprap	3.8.A				yes		yes	
Subgrade Construction								
measurement -topping (select soil)	4.6.A						yes[4]	
Portland Cement Concrete Paving								
cement: cert. plant	5.1.C						yes	
cement: non-cert. plant	5.1.C	yes			yes			
admixture	5.1.E		yes		yes			
fly ash	5.1.F	yes			yes			

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
fiber mulch	9.1.E	yes					yes	
peat moss	9.1.F	yes						
plants and shrubs	9.1.G	yes					yes	
seeds	9.1.H	yes			yes		yes	
BUILDING AND REST AREA CONSTRUCTION MATERIALS								
brick	10.1.A						yes	
insulation	10.1.B						yes	
building block	10.1.C							
basin & manhole block	10.1.D						yes	
misc. hardware items	10.1.E						yes[8]	
MISC. INCIDENTAL AND MFG. OR FAB. ITEMS								
Aluminum								
Cast, framing, Guard Rail, etc.	11.1.A	yes					yes	
Bearing Pads								
bronze or copper	11.2.B	yes					yes	
canvas and red lead	11.2.B						yes	
elastomeric	11.2.C	yes						
neoprene	11.2.D	yes				yes		
Bridge Drains								
materials	11.3.A						yes	
Castings								
bridge hardware	11.4.A	yes						
drop inlet, grates, box curb etc.	11.4.B	yes					yes	
grid floor	11.4.C	yes						
Cattle Guards								

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
material	11.5.A						yes	
Chloride								
calcium, sodium, & mag.	11.6.A				yes			
dust oil chlorides	11.6.B	yes			yes			
Epoxy-resin adhesive								
materials Bridge Dowel	11.7.A	yes						
materials: PCCP Dowel	11.7.A		yes					
Fencing								
barb wire	11.8.A				yes		yes[2]	
chain link	11.8.B	yes			yes		yes[2]	
woven wire	11.8.C				yes		yes[2]	
brace wire	11.8.D						yes	
misc. fasteners	11.8.E						yes	
gates	11.8.F						yes	
steel posts	11.8.G						yes	
chain link posts	11.8.H	yes					yes	
wood posts: site accepted	11.8.I		yes				yes	
wood posts: plant accepted	11.8.I						yes[9]	
Paint								
materials	11.10.A	yes			yes			
Pilings								
pre-cast pcc		yes			yes			
steel beam or sheet	11.11.B	yes						
timber	11.11.C	yes						
piling shoes	11.11.D						yes	

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Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Pipe								
concrete: wire mesh	11.12.A	yes				yes		
corrugated metal	11.12.B						yes[10]	
PVC and Polyethylene	11.12.C	yes						
Bit. coating	11.12.E	yes			yes			
Precast Pcc								
metal components	11.13.C	yes			yes			
Signing Materials								
aluminum, sheet	11.15.A	yes					yes	
aluminum, bolts	11.15.B						yes	
posts, steel	11.15.C	yes					yes	
posts, wood	11.15.C		yes				yes	
reflective sheeting	11.15.D	yes						
Steel								
bolts, nuts, washers	11.16.A	yes					yes	
A-307 Guard rail bolts	11.16.A						yes	
cable	11.16.B	yes						
smooth dowels	11.16.C	yes						
support baskets fop dowels	11.16.D						yes	
rebar, certified fab.	11.16.E						yes[11]	
rebar, non-certified fab. & coated	11.16.E	yes			yes			
wire ties	11.16.F						yes	
wire mesh, reinforcing	11.16.G						yes	
structural	11.16.H	yes					yes	
guard rail, posts, & bolts	11.16.I	yes					yes	

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Timber								
structural	11.17.A	yes						
guard rail posts, job site accept	11.17.B.(a)		yes		yes		yes	
guard rail posts, plant site accept	11.17.B.(b)						yes	
plank	11.17.C	yes					yes	
Gabions								
materials	11.18.A		yes		yes		yes	
Drainage Fabric								
materials	11.19.A	yes					yes	
Extr. Board								
materials	11.20.A	yes					yes[12]	
Controlled Density Fill								
materials & plan	11.21.A	yes						
Polyethylene sheeting								
materials	11.22.A							yes
Pavement Restoration								
Joint & Spall Repair								
pre-packaged mix	12.1.B.			yes				
silicone, in-place	12.1.D.						yes	
Pavement Jacking & Undersealing								
flow	12.2.E						yes	

[1] when density is not required.

[7] for production

[2] for small quantities
piece.
[3] to measure and record to assure compliance
[4] for thickness and width
[5] for size and quality
[6] if cert. analysis is on label
[8] inspect for U.L., NEMA, etc for each
[9] with tags
[10] if DOT-58 not available
[11] shipping record
[12] if cert is not available

Appendix B
Survey
Survey Results

Appendix A

Materials or Processes that Need to be Certified, be on the Approved Products List, and/or Documented by DOT-25

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Asphalt Construction								
Asphalt Concrete Composite	1.1.A	yes			yes			
rock, sand, filler	1.1.B				yes			
asphalt cement	1.1.C	yes			yes			
measurement	1.1.G						yes[1]	
Asphalt Surface Treatment								
Asphalt, Liquid	1.2.C	yes			yes			
Dust Oil	1.2.D	yes			yes			
Subbase, Base, and Cushion								
General Notes	2						yes[2]	
measurement	2.1.E						yes[3]	
Asphalt Treated Subbase								
Asphalt	2.2.C	yes			yes			
measurement	2.2.G						yes[4]	
Misc. Granular Fill								
gabion fill	3.6.A						yes[5]	
riprap	3.8.A				yes		yes	
Subgrade Construction								
measurement -topping (select soil)	4.6.A						yes[4]	
Portland Cement Concrete Paving								
cement: cert. plant	5.1.C						yes	
cement: non-cert. plant	5.1.C	yes			yes			
admixture	5.1.E		yes		yes			
fly ash	5.1.F	yes			yes			

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Measurement: thickness	5.4.C						yes[2]	
Curing Materials								
liquid membrane	5.5.A		yes		yes			
burlap	5.5.B						yes	
polyethylene sheeting	5.5.C						yes	
Joint Materials								
preformed expansion	5.6.A				yes		yes[2]	
hot poured elastic type	5.6.B		yes		yes			
silicone	5.6.C	yes			yes		yes[2]	
silicone and backer rod	5.6.C		yes		yes		yes[2]	
Keyways								
material	5.7.A						yes	
Oil Treatments								
materials	5.8.A		yes		yes		yes[2]	
Portland cement concrete masonry								
general notes	6	yes[2]						yes[2]
cement: Cert. plant	6.1.C						yes	
cement: non-cert. plant	6.1.C	yes			yes			
admixtures	6.1.E		yes		yes			
latex emulsion	6.1.G		yes		yes			
Curing Materials								
liquid membrane	6.4.A		yes		yes			
burlap	6.4.B						yes	
film (plastic sheeting, etc.)	6.4.C						yes	
Joint Materials								

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Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
strip seal, preformed elastomeric	6.5.A		yes				yes	
preformed expansion	6.5.B				yes		yes[2]	
hot poured elastic type	6.5.C		yes		yes			
silicone	6.5.D	yes					yes	
backer rod for silicone	6.5.D		yes				yes	
Commercial Textured								
materials	6.6.A			yes			yes	
Abutment backwall coating								
materials	6.7.A						yes	
Oil treatment								
treating oil	6.8.A		yes		yes		yes[6]	
Portland Cement Concrete (Class M)								
materials and plant	7.1.A.						yes[7]	
Roadway Lighting and Traffic Control								
materials	8.1.A						yes	
miscellaneous hardware items	8.1.B						yes	
items on APL	8.1.C						yes	
items requiring approval	8.1.D						yes	
items requiring mat. cert.	8.1.E	yes					yes	
ROADSIDE DEVELOPMENT MATERIALS								
burlap	9.1.A						yes	
fertilizer	9.1.B	yes						
fiber glass roving	9.1.C	yes					yes	
grass hay or mulch	9.1.D						yes	

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Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
fiber mulch	9.1.E	yes					yes	
peat moss	9.1.F	yes						
plants and shrubs	9.1.G	yes					yes	
seeds	9.1.H	yes			yes		yes	
BUILDING AND REST AREA CONSTRUCTION MATERIALS								
brick	10.1.A						yes	
insulation	10.1.B						yes	
building block	10.1.C							
basin & manhole block	10.1.D						yes	
misc. hardware items	10.1.E						yes[8]	
MISC. INCIDENTAL AND MFG. OR FAB. ITEMS								
Aluminum								
Cast, framing, Guard Rail, etc.	11.1.A	yes					yes	
Bearing Pads								
bronze or copper	11.2.B	yes					yes	
canvas and red lead	11.2.B						yes	
elastomeric	11.2.C	yes						
neoprene	11.2.D	yes				yes		
Bridge Drains								
materials	11.3.A						yes	
Castings								
bridge hardware	11.4.A	yes						
drop inlet, grates, box curb etc.	11.4.B	yes					yes	
grid floor	11.4.C	yes						
Cattle Guards								

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
material	11.5.A						yes	
Chloride								
calcium, sodium, & mag.	11.6.A				yes			
dust oil chlorides	11.6.B	yes			yes			
Epoxy-resin adhesive								
materials Bridge Dowel	11.7.A	yes						
materials: PCCP Dowel	11.7.A		yes					
Fencing								
barb wire	11.8.A				yes		yes[2]	
chain link	11.8.B	yes			yes		yes[2]	
woven wire	11.8.C				yes		yes[2]	
brace wire	11.8.D						yes	
misc. fasteners	11.8.E						yes	
gates	11.8.F						yes	
steel posts	11.8.G						yes	
chain link posts	11.8.H	yes					yes	
wood posts: site accepted	11.8.I		yes				yes	
wood posts: plant accepted	11.8.I						yes[9]	
Paint								
materials	11.10.A	yes			yes			
Pilings								
pre-cast pcc		yes			yes			
steel beam or sheet	11.11.B	yes						
timber	11.11.C	yes						
piling shoes	11.11.D						yes	

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Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Pipe								
concrete: wire mesh	11.12.A	yes				yes		
corrugated metal	11.12.B						yes[10]	
PVC and Polyethylene	11.12.C	yes						
Bit. coating	11.12.E	yes			yes			
Precast Pcc								
metal components	11.13.C	yes			yes			
Signing Materials								
aluminum, sheet	11.15.A	yes					yes	
aluminum, bolts	11.15.B						yes	
posts, steel	11.15.C	yes					yes	
posts, wood	11.15.C		yes				yes	
reflective sheeting	11.15.D	yes						
Steel								
bolts, nuts, washers	11.16.A	yes					yes	
A-307 Guard rail bolts	11.16.A						yes	
cable	11.16.B	yes						
smooth dowels	11.16.C	yes						
support baskets fop dowels	11.16.D						yes	
rebar, certified fab.	11.16.E						yes[11]	
rebar, non-certified fab. & coated	11.16.E	yes			yes			
wire ties	11.16.F						yes	
wire mesh, reinforcing	11.16.G						yes	
structural	11.16.H	yes					yes	
guard rail, posts, & bolts	11.16.I	yes					yes	

Appendix A. Materials or Processes that need to be certified, be on the Approved Products List, and/or documented by DOT-25

Construction Area / Material	M.S.T.R. Section	Certification Process Used			Method of Acceptance			
		Cert	APL or Cert. plus DOT-25	APL DOT-25	Sample	Sample if Cert. is not Avail.	Sample plus DOT-25	DOT-25 only
Timber								
structural	11.17.A	yes						
guard rail posts, job site accept	11.17.B.(a)		yes		yes		yes	
guard rail posts, plant site accept	11.17.B.(b)						yes	
plank	11.17.C	yes					yes	
Gabions								
materials	11.18.A		yes		yes		yes	
Drainage Fabric								
materials	11.19.A	yes					yes	
Extr. Board								
materials	11.20.A	yes					yes[12]	
Controlled Density Fill								
materials & plan	11.21.A	yes						
Polyethylene sheeting								
materials	11.22.A							yes
Pavement Restoration								
Joint & Spall Repair								
pre-packaged mix	12.1.B.			yes				
silicone, in-place	12.1.D.						yes	
Pavement Jacking & Undersealing								
flow	12.2.E						yes	

[1] when density is not required.

[7] for production

[2] for small quantities
piece.
[3] to measure and record to assure compliance
[4] for thickness and width
[5] for size and quality
[6] if cert. analysis is on label

[8] inspect for U.L., NEMA, etc for each

[9] with tags

[10] if DOT-58 not available
[11] shipping record
[12] if cert is not available

Appendix B
Survey
Survey Results

BRAUN™
INTERTEC

Braun Intertec Corporation
6875 Washington Avenue South
P.O. Box 39108
Minneapolis, Minnesota 55439-0108
612-941-5600 Fax: 942-4844

Engineers and Scientists Serving the Built and Natural Environments

December 17, 1996

Mr. Rick Harvey
Wyoming Department of Transportation
5300 Bishop Blvd.
P.O. Box 1708
Cheyenne, WY 82003-1708

Dear Mr. Harvey:

Re: South Dakota Department of Transportation Research Project SD96-06
Improvement of the Materials Certification Process

The South Dakota Department of Transportation has contracted with Braun Intertec Corporation to conduct a study of their Materials Certification Process. Part of the study involves developing and sending a questionnaire to the Materials Engineer of each State Transportation or Highway Agency to gather information on Certification practices.

Could you please forward this questionnaire to the person that works with material certifications in your agency? A copy of the South Dakota Request for Proposal is also included that gives an overview of the background and objectives of the study.

The South Dakota Department of Transportation and Braun Intertec Corporation sincerely appreciate your time and effort required to complete and return the questionnaire. Should there be any questions, please call me or Dan Johnston. Our telephone numbers and e-mail addresses are on the last page of the questionnaire. Thank you.

Sincerely,

Pamela Gaskin for

Erland O. Lukanen, PE
Principal

Enclosure

I: client96\sdakdot\qletter.ltr

Questionnaire to States
Use of Certifications for Materials Acceptance

Thank you for assisting the South Dakota DOT study ways to improve their use of certifications in the acceptance of materials for construction of their transportation system. We expect to improve their system in areas of design specifications, contractor responsibilities and project paperwork requirements. They will publish this information for use by others so that you may also benefit. We will send you a copy of the tabulated results before the report is published.

Please fill out the following questions and return this by **December 27, 1996.**

Are certifications used for accepting any of the following materials? Check Yes or No.			How are certifications used?			How are certifications verified?					
Material	Yes	No	Always Accepted	Accepted with Limits	Accepted through Approved Products List	Not Verified	Randomly Sampled and Tested by State	Other Agency Test Accepted	Tests by Commercial Laboratories Accepted	Site of Manufacture Visited Periodically by State	Comment on limits of uses or other comments. Use extra sheets if necessary.
Air Entraining Agents	✓			✓					✓		Certifications & product data info annually reviewed by WYDOT ENGINEERS.
Antistrip Additives		✓									
Asphalt Cement	✓			✓							Testing by WYDOT ON ALL loads of Asphalt Cement
Asphalt Emulsions	✓			✓							see Asphalt Cement
Coarse Aggregates		✓									
Fine Aggregates		✓									
Mineral Filler		✓									
Portland Cement	✓		✓	✓				✓	✓		chemical analysis reports req'd w/certification
Reinforcing Bars	✓			✓			✓		✓		mill test reports, req'd w/certification

Material	Are certifications used for accepting any of the following materials? Check Yes or No. Yes	No	How are certifications used? Always Accepted	Accepted with Limits	Accepted through Approved Products List	How are certifications verified? Not Verified	Randomly Sampled and Tested by State	Other Agency Test Accepted	Tests by Commercial Laboratories Accepted	Site of Manufacture Visited Periodically by State	Comment on limits of uses or other comments. Use extra sheets if necessary.
Structural Steel	✓			✓			✓				mill test reports req'd w/ certification
Water Reducers	✓			✓					✓		Certifications & product data info Annually reviewed by WYDOT Engineers
Bituminous Concrete		✓									
Bricks and Blocks	✓		✓			✓					
Concrete Pipe	✓		✓							✓	
Epoxies	✓		✓			✓					
Hardware, Guardrails, etc.	✓			✓							MILL TEST REPORTS req'd w/ certification
Incidental Concrete		✓									
Lighting Equipment	✓			✓		✓					submittals reviewed by Traffic Engineering staff.
Metal Pipe	✓			✓							mill test reports req'd w/ certification
Paints	✓			✓			✓				testing by WYDOT LABORATORY required
Signs	✓			✓		✓					submittals reviewed by Traffic Engineering Staff
Structural Concrete		✓									

Are certifications used for accepting any of the following materials? Check Yes or No.			How are certifications used?				How are certifications verified?					
Material	Yes	No	Always Accepted	Accepted with Limits	Accepted through Approved Products List		Not Verified	Randomly Sampled and Tested by State	Other Agency Test Accepted	Tests by Commercial Laboratories Accepted	Site of Manufacture Visited Periodically by State	Comment on limits of uses or other comments. Use extra sheets if necessary.
Traffic Signals	✓		✓									Submittals reviewed by Traffic Engineering Staff
Drainage Fabric or Other Geotextiles	✓		✓					✓				
Dust Control Chlorides	✓		✓				✓					
Gabions	✓		✓				✓					

What are/have been your significant problems and concerns with your certification program?

TOO MUCH PAPERWORK - DO CERTIFICATIONS TRULY REPRESENT THE MATERIAL?

Do you have materials installed before certifications are approved? ☒ Yes ☐ No

If yes, what do you do with failures?

PRICE ADJUST IF ISOLATED PRIOR TO FINAL PAYMENT.

Have you done anything to improve your certification processes? ☐ Yes ☒ No

Please describe.

We are particularly interested in bolts and other pieces of hardware.
If you have not commented on those items above, please address how you deal with them.

WE ACCEPT A-307 BOLTS ON CERTIFICATION, A-325 BOLTS ARE RANDOMLY SAMPLED & TESTED FOR ROCKWELL HARDNESS

Do you use processes that use warranties in lieu of certifications? ☐ Yes ☒ No
If so, please comment on the process and success of this approach.

Do you use processes that consider a "package" or "umbrella" certification of several associated items that together make up a bigger installation (e.g., bolts and structural members that make a complete guardrail)? ☒ Yes ☐ No
If yes, please comment on the process and success of this approach

We prefer to get certification for an entire assembly. This certification must be accompanied by mill test reports for the individual components.

Are there items that you accept without certification or testing? ☐ Yes ☒ No
What are they?

Do you have other comments you feel would be helpful to our study? ☐ Yes ☒ No

Thank you very much for your assistance. Please return this questionnaire in the enclosed envelope or to:

Erland Lukanen, PE
Principal Investigator
Braun Intertec Corporation
P.O. Box 39108
Minneapolis, Minnesota 55439-0108

If you have questions, you may contact:

Erland Lukanen, PE	or	Dan Johnston
Principal Investigator		Project Manager
Braun Intertec Corporation		South Dakota DOT
(612) 942-3041 (phone)		(605) 773-5030
(612) 942-3059 (fax)		(605) 773-3921
elukanen@brauncorp.com (e-mail)		danj@DOT.State.SD.US

If you are willing to be contacted for further information by phone or e-mail, please provide your name, phone number and e-mail address.

Name KEN HIXENBAUGH Wyoming 1/13/97
Telephone (307)777-4213
E-mail

South Dakota Department of Transportation
1996 Research Program

Problem Number: SD96-06

Title: Improvement of the Materials Certification Process

Problem Description: The Department invests considerable effort to certify materials for use on construction projects. Numerous certifications are required, creating an administrative burden for contractors and Department inspectors. In some circumstances, several documents are required to certify the components in an assembly due to various specification requirements (e.g., guardrail). Sometimes certificates are not received until after the material has been used and removal is impractical. It can also be difficult to guarantee that certification documents received actually apply to the materials used on the project. As a result, the effectiveness of certification in ensuring construction quality is questionable. The same certification requirements may not be necessary for all components used in construction. Research is needed to evaluate the Department's certification process and recommend improvements which will save both time and money while maintaining a supply of acceptable materials. The research will consider other states' procedures, examine the Department's specific product needs and propose a more efficient process.

Research Objectives:

1. To define the legal and regulatory requirements of a material certification process.
2. To develop alternative strategies for certification which will be simpler to administer, save time and be cost effective while addressing specific material requirements.

Research Tasks:

1. Meet with the technical panel to review the work plan and survey questionnaire for the research.
2. Review South Dakota DOT's current specifications for certification and available literature on material certification.
3. Conduct a survey of other states' material certification processes.
4. Interview material suppliers, contractors and Departmental personnel involved in the material certification process to gain an understanding of our process and the informational requirements thereof.
5. Determine the legal, liability and regulatory issues which may affect any changes in our current process.
6. Examine the feasibility of umbrella, component or other methods of certification by contractors of materials currently accepted on the basis of itemized manufacturer's certification only.
7. Evaluate the needs for certification based on material types and usages.
8. Develop methods for verification of material quality using revised certification processes.
9. Recommend specifications, policies or procedures which will allow implementation of a modified certification process.
10. Submit a final report summarizing relevant literature, research methodology, findings and conclusions.
11. Make an executive presentation to the South Dakota DOT Research Review Board at the conclusion of the project.

Material	Yes	No	Always Accepted	Accepted w/Limits	Approved Product List	Not Verified	Randomly Sampled	Other Agency	Tests by Commerical	Site of Manufacture
Air Entraining Agents	28	5	1	3	26	6	13	3	9	
Antistrip Additives	10	14		2	14	5	6		1	1
Asphalt Cement	29	8	5	3	15		24		2	10
Asphalt Emulsions	24	11	6	3	16	1	20		1	8
Coarse Aggregates	7	27		1	11		12	1		7
Fine Aggregates	7	26		1	10		14	1		7
Mineral Filler	7	23		3	3		7		1	1
Portland Cement	32	3	4	7	14		27		1	5
Reinforcing Bars	26	7	8	5	12		28	1	2	10
Structural Steel	26	6	7	12	4	5	8	2	6	8
Water Reducers	27	4	3	5	22	4	13	2	7	
Bituminous Concrete	6	28		4	2	1	5		2	3
Bricks and Blocks	11	21	3		2	2	9			2
Concrete Pipe	19	15	3	3	6		10	1	1	13
Epoxies	23	8	6	3	17	6	12	1	4	
Hardware, Guardrails, etc.	34		5	8	14	5	23	1	1	4
Incidental Concrete	8	24		6	1		4			2
Lighting Equipment	24	6	8	9	3	6	8			
Metal Pipe	24	8	4	8	11	2	19	1	3	6
Paints	22	9	7	16	2	17	1	2		
Signs	27	6	2	16	7	6	14	1	5	1
Structural Concrete	4	29		2	1		7			
Traffic Signs	25	7	5	11	8	6	7	1	4	
Drainage Fabric/Other Gextiles	27	5	5	9	11	3	13	3	6	1
Dust Control Chlorides	9	15	3	3	1	4	5	1	2	
Gabions	18	9	6	5	3	3	9	1	3	1

Failures	21	10	See Comments
Describe	17	11	
Warranties	4	29	
Package	17	19	
What are they	14	11	
Any other comments?	7	18	

Air Entraining Agents

WY	1	Certifications and product data info annually reviewed by WYDOT Engineers
PA	4	Approved on job-by-job basis.
IL	6	Department tests new products according to AASHTO M 154. Thereafter, specific gravity, non-volatile content and pH are checked if requested by district.
MT	9	Accepted based on manufacturer's certification and satisfactory field performance.
VA	12	Certified once with annual letter stating no change.
NE	14	Annual recertification to remain on APL
KY	19	Only require an "annual" certification.
?	21	Initial evaluation by DOT Lab. If satisfactory, added to Approved List. Unless problems suspected, no further tests.
IA	22	Sampled and tested on a par lot basis 0.5L/lot.
ID	23	Qualification testing only (no production testing)
?	24	Qualified Products List checked and approved or rejected annually by state.
MS	26	All concrete admixtures are initially approved by Materials Division from Certified Test Reports and placed on APL. Cert is required at plant.
IL	30	Department tests new products according to AASHTO M 154. Thereafter, specific gravity, non-volatile content and pH are checked if requested by district.
SC	33	Must meet AASHTO M-154. Certified affidavit from manufacturer.

Antistrip Additives

PA	4	Approved on job-by-job basis.
MT	9	Tested in our labs based on established sampling frequency.
VA	12	Initial test by state.
NE	14	None used at this time.
ND	15	Don't use.
KY	19	Products are tested once, and if okay, placed on list.
?	21	Not currently used by NYSDOT.
IA	22	Anti-strip agents (other than lime) are presently only used in high performance pre-mix.
ID	23	Qualification testing by state (no production testing)
MS	26	Usage of hydrated lime in bit. mixes has all but deleted the necessity of this.
M0	27	Not used. Hydrated lime required in bituminous mixes.

Asphalt Cement

WY	1	Testing by WYDOT on all loads of asphalt cement
WV	2	Acceptance based on supplier data verified by State test data.
WA	3	Every third shipment is sampled and tested for conformance to specifications.
MT	9	Tested in our labs based on established sampling frequency.
NE	14	One sample/2500.T. HMA
KY	19	Suppliers also sent in informational samples which are tested after shipment and use.
IA	22	Approved source
ID	23	We expect certification acceptance will be necessary under SHRP grading as SHRP tests very time consuming.
?	24	Monthly reports May thru October. Checked annually by state.
MS	26	All binders approved before placement on APL. They are pretested. Certificate "A" or "B" required with each shipment
M0	27	Approved producer list.

Asphalt Emulsions

WY	1	Testing by WYDOT on all loads of asphalt cement
WV	2	Acceptance based on supplier data verified by State test data.
WA	3	Every third shipment is sampled and tested for conformance to specifications.
MT	9	Tested in our labs based on established sampling frequency.
NE	14	Approved suppliers (otherwise sampled/test)
IA	22	Approved source. Polymer Modified. Accepted on an approved batch basis.
M0	27	Approved producer list.

Coarse Aggregates

WV	2	Quality only.
AR	5	QPL of sources with aggregate type and approved uses. Job accepted by testing for gradations.
MD	8	We do allow certified results from outside lab for polish value and alkali-silica reactivity tests.
MT	9	Tested in our labs based on established sampling frequency.
NE	14	Project samples for soundness/quality
KS	20	Class I paving aggregate and sand-gravels prequalified for D-cracking and ASR
IA	22	Approved source
?	24	Quality Assurance Procedures with Lab Quality Control checked annually.
SC	33	Gradation checked on a project by project basis. Must be from an approved source.

Fine Aggregates

WV	2	Quality only.
AR	5	QPL of sources with aggregate type and approved uses. Job accepted by testing for gradations.
MT	9	Tested in our labs based on established sampling frequency.
NE	14	Project samples for soundness/quality
IA	22	Approved source
?	24	Quality Assurance Procedures with Lab Quality Control checked annually.
SC	33	Gradation checked on a project by project basis. Must be from an approved source.

Mineral Filler

MT	9	Tested in our labs based on established sampling frequency.
NE	14	P.I. spec
IA	22	Do not differentiate between fine aggregate and mineral filler for purposes of acceptance.
?	24	Quality Assurance Procedures with Lab Quality Control checked annually.

Portland Cement

WY	1	Chemical analysis reports required with certification
MT	9	Tested in our labs based on established sampling frequency.
WI	10	List of approved manufacturers on annual basis.
OH	11	Initial test and monthly data accepted from manufacturer.
NE	14	Samples tested monthly from each source.
ND	15	One sample tested per project.
KY	19	One field check sample/200 tons
IA	22	Producers Quality Control Program monitored and reviewed. Random sample, lot basis.
ID	23	We reserve the right to test for acceptance at any time.
MS	26	Source approval. Certified test reports to batch plant and Materials Division.
M0	27	Approved producer list.

Reinforcing Bars

WY	1	Mill test reports required with certification
MT	9	Tested in our labs based on established sampling frequency.
WI	10	Certifications are used for minor quantities <5000#.
NE	14	Certifications required for all heat #5.
KY	19	One field check sample from each heat > 15,000 lbs.
IA	22	Approved source, assurance samples.
ID	23	See Portland Cement comment.
MS	26	Pretested. Shipping ticket to Materials Division. Certification required that it is shipped for pretested stock.
M0	27	Certification and testing.

Structural Steel

WY	1	Mill test reports required with certification
WV	2	Mill Test Reports from producer are reviewed 100%. Inspection of material is also required.
AR	5	CMTR's accepted for all steel. Inspection at Fabricator by State authorized personnel. Fabricator QC in 1996 specs.
MDE	8	Use agency inspectors for non-local sources.
MT	9	Hire consultants for out-of-state inspections.
NE	14	Mill tests from manufacturer.
KY	19	Annual contract for shop inspection by consultant for all bridge girders and components.
?	21	The base material is accepted based upon certified test results. Fabricated structural steel item typically require in process inspection and evaluation.
IA	22	Accepted based on mill test certifications and physical inspection at fabrication site.
ID	23	We reserve the right to test for acceptance, but very seldom do so. Welding shops visited periodically. We use commercial welding inspectors to monitor fabrication shop operation.
?	24	Mill test reports.
MS	26	MDOT contracts out to inspection agencies.

Water Reducers

WY	1	Certifications and product data info annually reviewed by WYDOT engineers
AR	5	After initial approval based on independent lab report, product is considered by job.
IL	6	Department tests new products according to AASHTO M 154. Thereafter, specific gravity, non-volatile content and pH are checked if requested by district.
MT	9	Accepted based on manufacturer's certification and satisfactory field performance.
VA	12	Same as air entraining agents.
NE	14	Independent lab tests ASTM C494 to retesting.
?	21	Initial evaluation by DOT Lab. If satisfactory, added to Approved List. Unless problems suspected, no further tests.
IA	22	Sampled and tested on a par/lot basis 0.5L/lot.
MS	26	See note on air entraining agents.
IL	30	Department tests new products according to AASHTO M 154. Thereafter, specific gravity, non-volatile content and pH are checked if requested by district.
SC	33	Certified affidavit from manufacturer.

Bituminous Concrete

PA	4	Tested for acceptance.
AR	5	Field tested
MD	8	Producer's plant is approved prior to providing material.
MT	9	Tested in our labs or field base on established sample frequency.
NE	14	Contractor testing of plant produced mix.
ND	15	Test all tankers.
KS	20	Except commercial grade less than 500 tons.
IA	22	Sampled and tested by contractor under Quality Management Asphalt Program, monitored by State.
MS	26	Tested by MDOT at batch plant, and on site.
M0	27	Except for commercial mix
NV	32	Certification for AC, samples for aggregate, AC, mineral filler

Bricks and Blocks

WA	3	Only minor usage.
AR	5	Very limited use
MT	9	Accepted based on manufacturer's certification and satisfactory field performance.
ND	15	Don't use.
?	28	We test block normally. On some small jobs, we may sometimes accept on Certs.

Concrete Pipe

WV	2	Reinforcing steel is accepted on approval list. Absorption test on concrete.
AR	5	At the present, all concrete pipe is tested.
MT	9	Testing and inspection at site of manufacture.
VA	12	QA/QC Program
NE	14	All material used in manufactured pipe needs certification.
ND	15	Have QC/QA inspection program.
KS	20	Certification program being considered at present.
IA	22	Approved producers subject to periodic plant inspections and testing of Monitor samples. Test report required for CL IV or higher.
ID	23	We have a "qualified producer" list. Visual field inspection by state.
MS	26	Source approval only. All pipe inspected and stamped.

Epoxies

IL	6	Other chemical adhesives for pavement dowel and tie bars accepted through approved products list.
MT	9	Tested in our labs based on established sample frequency.
NE	14	Annual recertification to remain on APL.
KY	19	Test products prior to inclusion on approved products list.
IA	22	Verified by Pull test, field performance.
MS	26	Acceptance based on MDOT test results and certification of same composition approved by MDOT.
IL	30	Other chemical adhesives for pavement dowel and tie bars accepted thru approved products list.
SC	33	ASTM C881. Approved for particular applications.

Hardware, Guardrails, etc.

WY	1	Mill test reports required with certification
IL	6	Brand registration and guaranteed per AASHTO M 180 for guardrail. Certification required for hardware.
OH	11	Galvanizing checked.
VA	12	Wood post tested
NE	14	Some product tests performed.
KY	19	Visually inspect products for workmanship and appearance. Check rails, posts, terminal sections for thickness at job site.
?	21	Guardrail and connecting hardware are accepted based upon certification except when components present a safety risk. Then, stock lot sampling and testing required.
ID	23	Check mostly for dimensions and coating thickness - mill reports used to verify metal composition and strength.
MS	26	Verified only for being furnished.
IL	30	Brand registration and guarantee per AASHTO M 180 for guardrail. Certification required for hardware.
SC	33	Base metal composition and strength by certification. Zinc coating verified by DOT testing.

Incidental Concrete

MT	9	Accepted based on satisfactory field performance and random sampling.
NE	14	Testing on site during placement.
ND	15	Always test.
?	21	If the quality of the concrete is suspect, additional evaluation made.
IA	22	Designation as small Quantity/Incidental subject to previous experience with approved plant producing the concrete.
ID	23	We reserve the right to test at any time.
M0	27	Except for commercial mix
NV	32	Certification for Cement, samples for cement, aggregate and water

Lighting Equipment

WY	1	Submittals reviewed by traffic engineering staff
MD	8	Limited testing performed, compared for most part against catalog cuts.
OH	11	Deflection test performed on poles after installation.
NE	14	Tests for APL
OK	16	Brochure Item
IA	22	Lighting materials are accepted by Approved Shop Drawing, Catalog Cut or test report.
ID	23	Poles checked for dimensions and coating thickness - mill reports for verifying metal properties.
MS	26	Verified and accepted by Traffic Engineering Division.
M0	27	Galvanizing and Dimensions
?	28	For high pressure sodium lamp ballasts and internally illuminated street name signs.
SC	33	Accepted on basis of approved shop drawings and catalog cuts.

Metal Pipe

WY	1	Mill test reports required with certification
WV	2	Corrugated metal pipe.
IL	6	Random samples of corrugated steel taken at in-state facilities. Workmanship and coating verified at job sites.
VA	12	QA/QC Program
?	21	Field measurements by project staff.
IA	22	Approved fabricator, fabricator cert and guarantee, monitor samples.
ID	23	See lighting equipment.
MS	26	Source approval. All pipe inspected and sealed.
IL	30	Random samples of corrugated steel taken at in-state facilities. Workmanship and coating verified at job sites.

Paints

WY	1	Testing by WYDOT laboratory required
WV	2	Batches of 200 liters or less are accepted on a one-time basis provided that the formulation has previously been approved in WVDOH Laboratory.
IL	6	Initial approval based on commercial lab tests. State tests on each batch thereafter.
MD	8	Random samples also taken at manufacturer's facility.
MT	9	Tested in our labs based on established sample frequency.
NE	14	Tested prior to being placed on APL.
ND	15	Test all lots.
OK	16	Traffic paint - No. Bridge paint - Yes.
KS	20	Except quantities less than five gallons.
IA	22	Based on approved manufacturer and test results on monitor samples.
ID	23	We check wt./gal., settling properties, IR signature
MS	26	Source formulation approved and fingerprinted. Every 5th lot sampled and tested.
IL	30	Initial approval based on commercial lab tests. State tests on each batch thereafter.
SC	33	Traffic paints must meet specifications. Bridge paints accepted through approved products list.

Signs

WY	1	Submittals reviewed by Traffic Engineering staff
WV	2	Sign components are accepted by mfg. certified test data only in cases involving an order of less than 10 signs and less than $3m^2$.
PA	4	PA DOT makes their own signs.
AR	5	Sheeting is by QPL, metal substrate by testing/certification.
IL	6	Response is for aluminum sheets and reflective sheeting.
MT	9	Tested in our labs based on established sample frequency.
NE	14	Reflectivity tested on project.
KY	19	Accept materials tested by NTPEP checks.
?	21	Approved list for reflective sheeting. Sign panels and characters are accepted by certification.
IA	22	Approved shop drawings. Reflective sheeting.
ID	23	We reserve the right to test, but seldom do so.
?	24	[Signs - Permanent] Manufacturer's Mill Certs combined by fabricator for certification.
MS	26	New signs - certification accepted. Used signs - Project Engineer inspects at night for acceptance.
IL	30	Response is for aluminum sheets and reflective sheeting.
SC	33	Reflective sheeting accepted by approved products list

Structural Concrete

PA	4	Tested for acceptance.
MT	9	Tested in our labs based on established sample frequency.
NE	14	Testing on site during placement.
ND	15	Always test.
IA	22	Grade inspection of air, slump beams, cylinders, % Conc. Reg. etc. Various individual components may be accepted on the basis of certification.
MS	26	Tested by MDOT.

Traffic Signals

WY	1	Submittals reviewed by Traffic Engineering Staff
MD	8	We also use catalog cuts to accept traffic items.
ME	13	All controllers tested by ME DOT.
OK	16	Brochure Item.
IA	22	Accepted similar to lighting materials. Covered by special provision.
ID	23	We reserve the right to test for acceptance at any time.
?	24	Determined by owning agency.
MS	26	Verified and accepted by Traffic Engineering Division.
?	28	We inspect the poles, bolts, etc. Our electrical unit tests the signal systems.

Drainage Fabric or Other Geotextiles

WA	3	Yes for minor quantities.
IL	6	Tested per project or warehouse lots of 15,000 square meters.
WI	10	Certifications and tests required for large quantities. Certifications for types R, HR and C.
KY	19	Test for grab strength, elongation, sewn seam strength, AOs permeability and flow rate, accept puncture and burst strength, trapezoid tear and UV by cert.
ID	23	We reserve the right to test for acceptance at any time.
IL	30	Tested per project or warehouse lots of 15,000 square meters.

Dust Control Chlorides

PA	4	Don't use this.
NE	14	Accepted by project engineer
OK	16	Do not use this item.
IA	22	Basis of acceptance. Test report.
ID	23	We reserve the right to test for acceptance at any time.
M0	27	Not used

Gabions

IL	6	Few applications
MT	9	Accepted in field based on conformance to plans.
ND	15	Don't use.
ID	23	We reserve the right to test for acceptance at any time.
IL	30	Few applications.

What are/have been your significant problems and concerns with your certification program?

WY	1	Too much paperwork - do certifications truly represent the material?
WV	2	Can't always get certifications notarized.
WA	3	Getting the field inspectors to realize that the mfg. certification is a test report and as such has value - not just another piece of paper.
PA	4	Keeping track of all the certifications. Making sure contractor/supplier gives the department a certification for every lot of applicable material or item.
AR	5	Printed updates of QPL cannot be done as quickly as desired. We now have updates available to Resident Engineers on a PC LAN.
CT	7	We do not have the staff necessary to fully verify materials certificates and/or certified test reports.
MD	8	Certifications not having actual test results as required, results did not compare to our lab results, tracking of certifications when manufacturing facility is visited. Identifying material to certifications when lot numbers, heat numbers, etc. are involved.
MT	9	Most of our materials are accepted through testing at either the field or our central lab. Some items such as rebar and fabric require certification but are accepted based on test results from our lab.
WI	10	Obtaining proper information on certification document. Retention of certifications for necessary time periods. Verification of certification.
OH	11	Traceability (?) of certifications to actual product.
ME	13	No major concerns at this time but we plan to review our verification procedures in the near future.
NE	14	Maintaining "Certifications/APL" manually is difficult. Recertification period for epoxies and admixtures in Nov 1 thru Dec 31.
ND	15	Possibility of accepting inferior material even though it is certified as meeting specification.
OK	16	Incomplete information and delays in receiving them.
?	18	Sometimes certifications come from sales representative and not from manufacturers.
KY	19	The fact that we have caught suppliers (just a few) that certified a material without doing their process control testing, that is, their certification was not based on actual test results on an on-going basis.

What are/have been your significant problems and concerns with your certification program? (Cont'd)

KS	20	Nearly identical to those outlined in the South Dakota problem statement. We would be interested in the results of this study.
?	21	A certification must receive a timely and thorough review by the approving authority, a difficult and tedious task. If problems are not identified and properly addressed, the certification process will become ineffective.
IA	22	Complexity and ease of use are concerns. We are presently reviewing Materials Certification and related processes to look for ways to improve the certification procedures.
ID	23	There is some concern that the low level of monitoring inherent in certification acceptance is insufficient to assure that no substandard material is accepted.
MS	26	We are satisfied with our current acceptance procedures, which have been implemented for some time with slight modifications.
M0	27	Truth detection. Certifications versus actual product.
?	28	The certificates sometimes are given by the suppliers - not the manufacturer. We require backup for such items as mill test reports, Buy America, etc.
FL	29	Proper certifications and not product data sheets.
NV	32	The Federal "Buy America Clause" on steel products for Federally Funded Projects and receiving certifications prior to placement or payment.
SC	33	Matching certifications to materials being supplied can be a problem.

Do you have materials installed before certifications are approved?
If yes, what do you do with failures?

WY	1	Price adjust if isolated prior to final payment
WV	2	The contractors are cautioned not to install any material until it is approved. If they elect to go ahead with installation, it is at their own risk. They are held responsible for removal and replacement should the material be rejected.
WA	3	Payment is withheld until an acceptable mfg. certification is provided by the contractor.
PA	4	Contractors are supposed to present certification before material is used but sometimes this is violated.
AR	5	The intent is to have certifications reviewed and approved prior to installation.
CT	7	We would pursue material replacement or appropriate cost reduction for substandard material.
MD	8	If material happens to get installed and fails to meet specs, we may ask for removal/replacement, credit or reduce payment for that item.
MT	9	Material is either removed and replaced or a price reduction is applied.
WI	10	Generally specifications are written to require certification of the project engineer before incorporation into work. Failures may be handled on an individual project sample basis or in the case of some materials, according to specifics of the certification acceptance program.
OH	11	Require removal or, in some cases, accept at reduced payment.
VA	12	Removed
ME	13	Several options are used. 1) Ban use of material on future projects until corrective action taken 2) Price reduction if minor failure 3) Remove and replace failing material with acceptable material
NE	14	There are some "remove & replace"
ND	15	Price deduct or if seriously deficient, it is removed.
OK	16	Remove and replace or apply pay deductions.

Do you have materials installed before certifications are approved? (Cont'd)
If yes, what do you do with failures?

KY	19	Many products or those products that we are equipped to test are check sampled at some frequency. If those samples fail, there is usually a deduction schedule for marginal failures or maybe a "no pay" or remove and replace for significant failures.
KS	20	It depends on the situation and the risks involved. If it's structural fasteners on a bridge, all in the lot(s) get removed and replaced. If the location of the lot(s) cannot be positively identified, then everything suspect is removed and replaced (not a pretty sight!!). If it's reinforcing mesh in a ditch line on grade, some cost adjustment below the bid price will be made. Options is to remove and replace.
?	21	The contractor is responsible to use materials conforming to the specifications. If it is determined that installed material does not conform, it is rejected.
IA	22	Handled on a case by case basis. Price adjustment, remove and replace may be in order depending on situation.
ID	23	Theoretically not, but it does happen sometimes. A decision must be made, based on the individual situation, as to whether complete removal is required, or whether price adjustment is appropriate.
?	24	Pay adjustments or removal, decision by P.E.
GA	25	On-site evaluation - remove and replace if necessary.
MS	26	They can be installed before acceptance, at the contractor's discretion. However, the materials are not paid for until all required certifications are received. These materials are subject to required replacement, or there may be a penalty adjustment.
M0	27	May be installed, but not approved until inspected and accepted.
?	28	Once material arrives at job site, the Resident Engineer will approve. There may be cases where material is installed before all certs have been checked out.
OR	31	Policy dictates we have certification prior to installation. Failures on installed materials become exceptions and depending on severity become 100% state funded.
NV	32	The Construction Division is responsible for this decision.
SC	33	A price reduction or material replaced at contractor's expense.

Have you done anything to improve your certification process?
Please describe.

WA	3	Establish a qualified products list which allows acceptance of certain products without prior approval of source and in some cases with reduced acceptance criteria.
AR	5	Resident Engineers document QPL usage which is used by Materials Division to track product usage and to take random samples.
IL	6	For cement field samples, the districts are instructed each month on the number of samples required for the central laboratory. This has reduced testing and provided a uniform distribution of samples throughout the state.
MD	8	We require certifications to have actual test results for properties specified, must be signed by authorized official of company, and any discrepancies between our test results and certifications require written explanation by producer, manufacturer, etc.
WI	10	Established specific program for asphalt cements, portland cements, secondary bridge metals for manufactured products accepted by certification. WIDOT has prime contractor maintain certifications but can review on 24 hour notice. Continued review keeps certification program current.
OH	11	Established failure rates that result in removal from certification program. Reserve the right to sample randomly.
NE	14	Providing a listing of certifications which are required to the project manager at beginning of project.
ND	15	Increased random testing.
KY	19	Have an Approved Products List for most certified products, take check samples at some frequency when possible, have a deduction schedule, and a requirement that 2 or 3 failures out of "x" number of check samples results in either "probation" or "off" the Approved Products List.
KS	20	1) By keeping the format, e.g., signature requirements, etc., as close as possible to that called for in the recognized industry standards (AASHTO, ASTM, etc.) for that material. 2) By maximizing the use or prequalified lists in high volume commonly used materials. It gives added clout in that problem suppliers can be dropped from the list and prohibited from furnishing to state jobs. 3) By keeping the level of certification as low as possible commensurate with the risk involved. Types of certs are as follows: Type A - Lot by lot test results. Type B - Range of test results from QC testing of previous lots.

Have you done anything to improve your certification process? (Cont'd)
Please describe.

Type C - Prequalified material. Certified as the same as that prequalified.
Type D - General certification. The material meets the specifications.
Type E - Composite item incorporating two or more certifiable or prequalified materials.

?	21	We provide the project staff with specific generic information required to be included in a certification. Staff is available in our regional offices and/or central office to assist in resolving problems.
IA	22	We recently surveyed users to determine where improvements might be made, the system simplified or clarified. In general, the survey results indicate that the system works fairly well given the limited training emphasis that Materials Certification receives. We plan to look at reducing the number of different types of certifications and increasing the awareness and training concerning certification and acceptance of materials.
ID	23	We are doing somewhat more spot checking than in the past. For some specialized testing (silicone joint sealant for PCC pavement, for example) we sample the item and sent to a commercial lab.
?	24	Require quality control plans by manufacturer and periodical inspection.
MS	26	QC/QA programs are impending for bituminous pavements, concrete, and aggregates, which may change some of the certification processes for these materials.
M0	27	Try to restrict certifications to less liable, easily checked items.
FL	29	In conjunction with the new FHWA policy, FDOT certification program will be updated to include more verification testing.
IL	30	For cement field samples, the districts are instructed each month on the number of samples required for the central laboratory. This has reduced testing and provided a uniform distribution of samples throughout the state.
OR	31	Oregon has a variety of groups which review this process on an ongoing basis. We are moving more items to our approved/qualified list and reviewing the meaningfulness of other items.
NV	32	Better communication with field personnel and the Materials Division. Also, distribution of AASHTO Manuals to field personnel.
SC	33	Require supplier to have a documented Quality Control program.

Do you use processes that use warranties in lieu of certifications?
If so, please comment on the process and success of this approach.

WA	3	Only for turn-key building projects and some very specialized equipment in movable span structures.
PA	4	Not yet. We are looking into warranties.
MD	8	We are just starting to look at using warranties for coatings used to paint our steel bridges.
WI	10	On occasion if a certification certificate cannot be produced, a warranty is sometime accepted.
IA	22	Have not developed use of warranties for materials.
?	24	Just starting to look at these programs.
MS	26	Lighting and traffic items are handled by Department specialists - Materials Division cannot comment on their question.
M0	27	Experimental. Warranted material based on performance and "technically" replaced if failed. This is a problem with Department of Transportation's low bid work. Certified material is based on specifications and may not have anything to do with performance. Easy to certify - hard to catch.
FL	29	We will be using more in the future.
OR	31	Oregon typically requires a one year warranty on bridge painting. We also require a 10 year or permanent sign sheeting.
SC	33	Traffic paint and themosplastic have a 180-day warranty period.

Do you use processes that consider a package or umbrella certification of several associated items that together make up a bigger installation (e.g., bolts and structural members that make a complete guardrail)?
If yes, please comment on the process and success of this approach.

WY	1	We prefer to get certification for an entire assembly. This certification must be accompanied by mill test reports for the individual components.
WV	2	Yes, but testing of the individual components by the DOH is generally done prior to inclusion in the "package."
WA	3	Guard rail is certified by the installer for rail elements, anchors, and posts and blocks. Bolts are A-307's which we accept without certification. So far no know problems, other items such as post-tension systems - except the strand or Bar, which is tested separately.
PA	4	If the unit is assembled on the job, the individual parts must almost always be certified.
AR	5	Traffic signal installations have been accepted based on a contractor certification of the entire installation.
VA	12	Guardrail accepted with hardware as package with the exception of treated wood post are inspected and tested. Suppliers required to maintain file of steel mill analysis.
OK	16	This works fairly well for fabricated items if you require them to furnish backup data and certs.
KY	19	We have approved supplier list with annual certifications that all material shipped will comply with specifications. Then each shipment is accompanied by "package" certification. All material is given a visual check and then the thickness of coating is verified (by job site personnel) on the posts, rail, and terminal sections.
KS	20	Our Type E Certification is for a composite item incorporating two or more certifiable or prequalified items. It states that all materials used in fabrication of the item in question were previously approved for Department use. The process is normally monitored by our regional materials inspectors in the fabricator's shop, who handles acceptance of the components.
?	21	We provide a form (certification) for each type of guardrail system. The form lists the components and requires the erector to enter the manufacturer, galvanizer and date(s) of certification for each component. The erector must retain the manufacturer's certifications listed for seven years for review upon request. This form, submitted by the erector, must be approved before payment.

Do you use processes that consider a package or umbrella certification of several associated items that together make up a bigger installation (e.g., bolts and structural members that make a complete guardrail)?
If yes, please comment on the process and success of this approach. (Cont'd)

IA	22	Guardrail is measured and paid for by lineal measure, number of posts by count and by number of and anchorage units.
ID	23	This would include light poles and bolts, signal poles and bolts (including anchor bolts in both cases). In these instances, I am not aware of any particular problems.
?	24	Structural steel. Permanent signs.
GA	25	Difficult to guarantee that certifications represent material used.
MS	26	Structural bolts - paints and coatings - bridge joint assemblies - we are very particular about testing, and placement on APL, such that our success rate is good.
M0	27	Guardrail end treatment - brand names - problem with manufacturers changing internally with no notification and possible bad effect.
SC	33	MSE walls are accepted as a unit. This approach is still in the developmental stages.

Are there items that you accept without certification or testing?
What are they?

WA	3	These are mostly low risk items and are identified in the Qualified Products List as category "A" items.
CT	7	We physically test the majority of these items.
WI	10	Minor noncritical may be accepted by field inspection from the project manager.
VA	12	Miscellaneous materials for general or routine construction. Too many to list.
ME	13	Small quantities of aggregates or bituminous mix may be visually inspected and accepted. Items are tested if any doubt in quality of product.
NE	14	High density polyethylene sheeting (1/2" thick), Black Jack Board White polyethylene sheeting (4mm thick)
ND	15	Items on a project that are under $5000 and not directly involved with the safety of the structure or roadway.
?	18	Minor items or small quantities.
KY	19	Cork, city water
KS	20	Small quantities in non-critical situations. Also, there are those who contend that our acceptance with a Type D (general) certification is tantamount to acceptance without certification or testing. However, there is legal recourse if the discrepancy is blatant, and the situation serious enough. Also we don't use it in high risk applications.
IA	22	Basically no. We do make allowances for small quantities.
?	24	Most small quantities are visually inspected.
MS	26	See SOP# TMD-20-05-00-000
M0	27	Small quantities of most items. Non-critical items based on visual inspection - rock lining, etc.
OR	31	Water, some temporary items etc. See attached acceptance guide.

Do you have other comments you feel would be helpful to our study?

IL	6	Certification is necessary when there are insufficient state personnel to test materials.
MD	8	We have assigned only higher level technicians to review and approve certifications. Inspectors, testers, etc. need to be trained in how to review certifications, what tests are critical to that material, and how to sample materials correctly.
KY	19	We believe certification acceptance can be an effective system if there is some way to perform random checks or verifications and then have consequences if the certification is not valid.
IA	22	This is a difficult subject. Iowa is working toward more contractor/supplier involvement in Quality Control programs, and looking at the possibilities of systems approaches in several areas. We have several quality groups established which are reviewing the processes involved with materials certification and acceptance looking for ways to improve. I have enclosed a copy of our IM 204 and IM 204 supplemental which I hope will give you an overview of Iowa's Materials Certification and acceptance program.
?	28	Unless you have a program to sample and test materials, the certificates are not very useful. As part of our Quality Assurance of materials, we have a Source Inspection program where we inspect, sample, and test materials prior to shipment to the job site.
IL	30	Certification is necessary when there are insufficient state personnel to test materials.
OR	31	Attached, I have enclosed our "non-field" testing requirements. Please contact me if you have any questions.

WY	1	Ken Hixenbaugh	Wyoming		307.777.4213	
WV	2	Gary L. Robson	West Virginia		304.558.3039	
WA	3	Francis A. Rickert	Washington		360.709.5411	
PA	4	David Reidenouer	Pennsylvania		717.787.2489	
PA	4	Rich Romberger, Steel products	Pennsylvania		717.787.4030	
PA	4	Dean Maurer, Bituminous	Pennsylvania		717.787.5229	
AR	5	Jim Gee, Materials Engineer	Arkansas		501.569.2185	
IL	6	Richard W. Hahn	Illinois		217.782.7200	
CT	7	Charles E. Dougan, Ph.D., P.E.	Connecticut		860.258.0372	
MD	8	Woodrow L. Hood	Maryland		410.321.3552	
MT	9	Jack Roberts	Montana DOT		406.444.6286	
WI	10	John B. Volker	Wisconsin		608.246.7930	
OH	11	Donald K. Huhman	Ohio DOT		614.275.1301	
VA	12	Richard Steele	Virginia		804.328.3105	
ME	13	Bruce Yeaton	Maine		207.287.2171	
NE	14	Laird E. Weishahn	Nebraska		402.479.4675	
ND	15	Darcy R. Rosendahl	North Dakota		701.328.6903	
OK	16	Jack Telford	Oklahoma		405.521.2677	
NH	17	Alan Perkins	New Hampshire		603.271.1660	
	18	Postmarked Mpls.				
KY	19	Jim Stone, Director - Div. of Materials	Kentucky		502.564.3160	
KS	20	Jim Clowers	KS DOT		913.296.3711	
	21	Ken Clements	Postmarked Mpls.	NYSDOT (?)	518.457.5642	
IA	22	John M. Heggen	Iowa		515.239.1003	[Hi Luke! JMH]
ID	23	A.F. Stanley	Idaho		208.334.8443	
	24	Stephen L. Purdy	MDOT		517.322.5665	
GA	25	Ronnie Conner	Georgia		404.363.7572	
MS	26	Jerry Calloway	Mississippi		601.944.9119	
MO	27	Tom Keith, Materials Division	Missouri DOT		573.751.3759	
	28					
FL	29	Richard J. Kesseler (for L. L. Smith)	Florida		352.337.3205	
IL	30	Richard W. Hahn	Illinois		217.782.7200	
OR	31	Dan Anderson	Oregon		503.986.3027	
		. Contract Services (Final Quality, Final Quantity, Payments)				
NV	32	Wes Clyde	Nevada		702.888.7792	
SC	33	W. M. Sawyer	South Carolina		803.737.6686	

Material	Yes	No	Always Accepted	Accepted with Limits	Approved Product List	Not Verified	Randomly Sampled	Other Agency	Tests by Commerical	Site of Manufacture
Air Entraining Agents	(28)	(5)	(1)	(3)	(26)	(6)	(13)	(3)	(9)	
Antistrip Additives	(10)	(14)		(2)	(14)	(5)	(6)		(1)	(1)
Asphalt Cement	(29)	(8)	(5)	(3)	(15)		(24)		(2)	(10)
Asphalt Emulsions	(24)	(11)	(6)	(3)	(16)	(1)	(20)		(1)	(8)
Coarse Aggregates	(7)	(27)		(1)	(11)		(12)	(1)		(7)
Fine Aggregates	(7)	(26)		(1)	(10)		(14)	(1)		(7)
Mineral Filler	(7)	(23)		(3)	(3)		(7)		(1)	(1)
Portland Cement	(32)	(3)	(4)	(7)	(14)		(27)		(1)	(5)
Reinforcing Bars	(26)	(7)	(8)	(5)	(12)		(28)	(1)	(2)	(10)
Structural Steel	(26)	(6)	(7)	(12)	(4)	(5)	(8)	(2)	(6)	(8)
Water Reducers	(27)	(4)	(3)	(5)	(21)	(4)	(13)	(2)	(7)	

Material	Yes	No	Always Accepted	Accepted with Limits	Approved Product List	Not Verified	Randomly Sampled	Other Agency	Tests by Commerical	Site of Manufacture
Bituminous Concrete	6	38		4	2	1	5		2	3
Bricks and Blocks	11	21	3		2	2	9			2
Concrete Pipe	19	15	3	3	6		10	1	1	13
Epoxies	23	8	6	3	17	6	12	1	4	
Hardware, Guardrails, etc.	34		5	8	14	5	23	1	1	4
Incidental Concrete	8	24		6	1		4			2
Lighting Equipment	24	6	8	9	3	6	5			
Metal Pipe	24	8	4	8	11	2	19	1	3	6
Paints	22	9		7	16	3	17	1	2	
Signs	27	6	2	16	7	6	14	1	5	1
Structural Concrete	4	29		2	1		7			

Material	Yes	No	Always Accepted	Accepted with Limits	Approved Product List	Not Verified	Randomly Sampled	Other Agency	Tests by Commerical	Site of Manufacture
Traffic Signs	(25)	(7)	(5)	(11)	(8)	(6)	(7)	(1)	(4)	
Drainage Fabric or Other Gextiles	(27)	(5)	(5)	(9)	(7)	(3)	(13)	(3)	(6)	(1)
Dust Control Chlorides	(7)	(15)	(3)	(3)	(1)	(4)	(5)	(1)	(2)	
Gabions	(18)	(9)	(6)	(5)	(3)	(3)	(9)	(1)	(3)	(1)
Failures	(21)	(10)								
Describe	(11)	(11)								
Deal										
Warranties	(5)	(29)								
Package	(17)	(19)								
What are they	(14)	(11)								
Any other comments?	(7)	(18)								

Appendix C
FHWA Letter

Appendix C. Draft FHWA Letter

U.S. Department of Transportation
Federal Highway Administration

Re: Request Approval of Changes to Acceptance of Materials Plan

The Department has studied the processes used for accepting materials used in construction of federal-aid highways and wishes to make limited revisions to some of those processes. Revisions of the use and verification of manufacturer's certifications will improve the efficiency of acceptance and maintain the quality of the constructed roadways. These changes are prompted by the improvements in manufactured products, manufacturer's control of products for uniformity and the need to accomplish the acceptance program with fewer staff.

We believe these changes allow us to continue to meet the requirements set forth in 23 CFR Ch. I, Part 637, and the and the policy and required provisions set out in Volume 6, Chapter 4, Section 2, Subsection 7 of the Federal Aid Highway Program Manual.

Briefly, we propose to add an "umbrella" certification process which will require a contractor to provide a list of materials and the relevant certifications to the engineer but maintain the actual certifications in their project files. The project files and constructed systems are subject to random audits for accuracy and completeness of certifications, with disbarment penalties for failures. The specific certification methods by which various materials and products will be accepted have been reevaluated to reflect the improved ability of manufacturers to produce materials and products that consistently meet the specifications. Details of the changes are shown on the attached Appendices.

Other changes relate to the details of the processes internal to the Department and not to the function of purposes of acceptance by certifications.

The request for changes is a result of a research study of the processes used by the Department for acceptance by various forms of manufacturer's certifications. The study, SD96-06 Improvements of the South Dakota Material Certifications Process, was conducted from October, 1996 to November, 1997. Data was gathered through a literature search, a survey of other state highway agencies, and interviews of Department staff, highway contractors and materials suppliers.

It is our opinion that the changes requested are not different than processes which are accepted by the Federal Highway Administration for several other states.

In addition to the limited changes we will be reemphasizing the various processes through communications to the industry and specific training on the certification processes for Department staff , contractors and manufacturers involved in the processes. We expect to be able to accomplish materials acceptance quicker, with less rework when procedures are not followed, after the implementation of the new processes.

We look forward to your acceptance of these limited changes. We propose to begin implementation of them with contracts let after June 1, 1998. We would appreciate your response by April 1, 1998 so we can plan for the implementation date.

Questions may be addressed to this writer at (605) 773-???? or by e-mail at ???????.

Sincerely,

Larry Engbretch, P.E.
Chief Materials and Surfacing Engineer

attach: Umbrella Certification Process Description and Flow Diagram
Array of Certification Methods and Materials

Appendix D
Communications Outline

Appendix D. Communications Outline

Purpose of Certifications

- "To assure, with reasonable risks, the material meets the specifications"
- Reduce the amount of testing the Department has to do
- Represents the quality control testing of the manufacturer

Value of Certifications

- Highway user gets a safe, efficient highway
- Design engineers can specify with confidence
- Construction engineers have basis for accepting materials that fulfill the design
- Contractors and manufacturers have basis for fair, competitive bidding

Types of Certifications and Verifications

- Array of 5 certifications and 4 verifications
- Method of certifying based on convenience
- Method of verification based on risk of failure

Need for Verifications

- Certifications without verifications are worthless
- Verification represents quality assurance testing
- Not used for acceptance directly

Goals of Changes

- Reduce time and effort required by all
- Reduce delays in processes
- Reduce "hassle" and rework
- Maintain quality of construction

Changes to be Implemented

- DOT-14 becomes basis for control of total processes
    - DOT-14 in bid documents
    - contractors and suppliers can use it
    - Department engineers continue to use it

Changes to be Implemented

- Adding Umbrella Certification Process
  - Certification of all parts of a system by one list
  - Contractor maintains actual certifications in their file
  - Verification of process by random audit after construction
  - Use for:
    - guard rails
    - traffic signals
    - lighting
    - fencing

Changes to be Implemented

- Require two copies of certifications to be delivered to Area Engineer before payment is authorized
  - one copy to Certification Engineer
  - one copy for Construction Payment Estimate

Changes to be Implemented

- Allow installation before certification is delivered to Area Engineer
  - random test samples still required for some materials
  - Area Engineer must check that certifications match materials and materials meet specifications (except umbrella certifications)

Changes to be Implemented

- Training in the processes to make it go well
  - Detailed instruction in the new processes for engineers, contractors and manufacturers
  - Manuals and handouts for reference

Changes to be Implemented

- Evaluations
  - Department staff evaluated and documented for performance evaluation
  - Contractors evaluated and reported to prequalification list
  - Look for opportunities to improve the processes

Training Schedule

- Classes to be held at SDDOT, AGC, SDSPE, CEC/SD meetings

Appendix E
Training Outline

Questions on Manufacturer's Certifications Process

???

Approved Products List

- Process flow diagram
- Changes (??) in Specifications

Questions on Approved Products List Process

???

Certified Fabricators, Mills and Plants

- Process flow diagram
- Changes in Specifications

Questions on Certified Fabricators, Mills and Plants Process

???

(1) Material Certification and Material-Certification Effectiveness, National Cooperative Highway Research Program Synthesis of Highway Practice No. 102, Transportation Research Board, Washington, D.C., November 1983.

(2) Synthesis 212: Performance-Related Specifications for Highway Construction and Rehabilitation, Transportation Research Board, National Research Council, Washington, D.C., 1995.

(3) Comparison of End Result and Method Specifications for Managing Quality, Transportation Research Board, Record No. 1491, 1995.

Appendix E. Training Outline

Purpose of Certifications

- "To assure, with reasonable risks, the material meets the specifications"
- Reduce the amount of testing the Department has to do
- Represents the quality control testing of the manufacturer

Value of Certifications

- Highway user gets a safe, efficient highway
- Design engineers can specify with confidence
- Construction engineers have basis for accepting materials that fulfill the design
- Contractors and manufacturers have basis for fair, competitive bidding

Types of Certifications and Verifications

- Array of 5 certifications and 4 verifications
- Method of certifying based on convenience
- Method of verification based on risk of failure

Need for Verifications

- Certifications without verifications are worthless
- Verification represents quality assurance testing
- Not used for acceptance directly

Goals of Changes

- Reduce time and effort required by all
- Reduce delays in processes
- Reduce "hassle" and rework
- Maintain quality of construction

Summary of Study Leading to Changes

- SD96-06 Improvements of the South Dakota Material Certification Process
- Research included
  - literature search
  - survey of other states
  - interviews of engineers, contractors, suppliers
- Recommended building on good processes
- Major changes recommended include
  - DOT-14 used a control throughout processes
  - added Umbrella Certification process
  - automation of processes ??????

Policy Changes

- New emphasis on following processes
- Required certifications must be provided by contractor before payment
- Department will train, then evaluate and discipline staff who do not process certifications correctly and timely

Manufacturer's Certifications Process

- Changes from previous written process
  - Contractor must provide certifications before payment will be authorized
  - Contractor must provide two copies of certifications
  - Area Engineer sends one copy to Certification Engineer and uses one copy as part of Construction Payment Estimate

Revised DOT-14 Form

- In all projects it will be done before bidding
- Available electronically for use by contractors and Area Engineers

Manufacturer's Certifications Process

- Process flow diagram
- Changes in Specifications