Construction Manual

State of Montana
Department of Transportation

Construction Bureau
2701 Prospect Avenue
Helena, Montana 59620

1997

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Chapter One

General Information

Department Organization

The Department is headquartered in Helena, with selected functions delegated to five district offices.

The responsibility and authority assigned to the Helena headquarters and the districts is broadly defined as follows:

All authority and responsibility for the operation of the Department, other than that provided by statute, is vested in the Director of the Department. The responsibility and authority for developing and evaluating Department policy is reserved to the Director. The responsibility and authority to supervise and administer the operation of all Department functions assigned to the districts are delegated to the district engineers/administrators. Division administrators have authority and responsibility for supervising and administering functions of the Department not assigned to the districts. The district engineers/administrators and division administrators follow established policy in performing their assigned functions.

District Responsibilities and Organization

Responsibilities

The major construction-related functions assigned to the districts are:

- preparing and administering budgets;
- supervising and administering personnel;
- administering construction contracts;
- inspecting contractors' work on projects;
- developing traffic control plans;

- conducting post-grading and pre-completion project inspections;
- preparing progress and final estimates;
- approving change orders (up to $10,000 on non-partnered projects);
- reviewing and recommending resolution of contractor claims;
- reviewing cost reduction proposals and recommending action;
- conducting final inspections; and
- recommending assessment of liquidated damages.

District Organization

District Engineers/Administrators have the overall responsibility for and direction of all assigned construction functions within their districts. A staff is assigned to assist them.

District Construction Engineers, as members of the district engineers' staffs, are responsible for administering assigned construction functions within each district. They supervise the engineering project managers and are the managers' primary source of direction for the proper administration of construction contracts and advice on construction problems. They are the first step in contractor appeals from decisions made at the project level. They are responsible for administering the District construction operating budget and monitoring the use of manpower through the construction management system.

Assistant District Construction Engineers are assigned to certain areas with high construction work loads to assist the District Construction Engineers with their duties and responsibilities.

Engineering Project Managers are responsible for administering and managing one or more construction projects. This involves:

- supervising engineering surveys, inspection and testing, and record keeping;
- evaluating and assessing contract time;
- interpreting plans and specifications;
- preparing estimates for contractor payment;
- initiating and preparing necessary change orders and extra work orders;
- documenting pay quantities; and
- evaluating and documenting compliance with the contract requirements.

Managers maintain an open line of communication to promote proper and timely completion of assigned projects.

Each Manager is assisted by a crew to perform office, surveying, inspecting, and testing duties. The size and make-up of each crew varies according to the type and size of assigned projects in accordance with the Construction Management System Manual. The CMS Manual will be consulted for guidance on crew sizes and make-up when making crew assignments.

The ***District Engineering Services Supervisors*** are involved to some extent in construction functions through their responsibility for and supervision of the district labs. The district labs sample and test materials and maintain records of samples and test results. They are the final authority at the District level on what is required for project records and documentation.

The ***District Materials Supervisors*** are responsible for ensuring that materials for construction projects are sampled and tested in accordance with established policies and procedures. They assist managers in interpreting and evaluating test results, and they provide technical advice on materials or construction problems related to testing.

Other district staff members also support construction functions in areas such as supplies, clerical, vehicles, and the like.

Helena Headquarters Responsibilities and Organization

Responsibilities

The Construction Bureau is responsible for these construction-related functions:

- reviewing and getting construction projects to contract;
- developing policies and procedures for contract administration and inspection;
- maintaining the Construction Manual to keep it current;
- developing specifications;
- evaluating new construction methods and procedures;
- issuing notices of award and notices to proceed;
- processing and approving subcontracts;
- reviewing traffic control plans;
- preparing project status reports;

- monitoring project inspection practices;
- reviewing bridge falsework and cofferdam drawings;
- setting pile lengths and approving spread footing foundations;
- transmitting shoring and falsework drawings to railroads;
- approving sign and electrical shop drawings;
- supervising prestress plant inspections;
- ordering survey equipment/computers for district construction crews;
- approving major change orders (above $10,000);
- investigating damage and defects in structural elements;
- resolving contractor claims that reach impasse or litigation;
- evaluating cost savings proposals;
- approving final estimates, monthly progress estimates; and
- coordinating with other state agencies.

Organization

The ***Administrator,*** Engineering Division, is responsible for and has the authority to supervise and administer all engineering functions not assigned to the districts. The construction function is under the Administrator's direction.

Construction Bureau

The ***Construction Engineer*** has the responsibility and authority to administer and supervise the construction functions assigned to the Engineering Division. The Construction Bureau staff assists in carrying out these responsibilities.

The ***Change Order Section*** processes change orders and extra work orders. The section prepares specifications for the purchase of surveying equipment; and arranges for surveying equipment repairs.

The ***Specifications Section*** reviews and develops new and revised specifications and standard detail; processes Supplemental Specifications and obtains FHWA approvals; and periodically updates and publishes new editions of the Standard Specifications and Standard Details.

The ***Contractor Estimate Section*** processes all contract estimates — both progress and final — for submission to Accounting for payment, including reviewing the final estimates and supporting documentation and submitting the necessary documentation to FHWA to close out completed projects.

The ***Construction Review Section*** monitors construction inspection and contract administration of construction projects through field inspections. For projects under Stewardship Agreement procedures, this section conducts periodic reviews which replace those formerly conducted by FHWA personnel. The Section reviews plans and specifications for compatibility with construction practices and consults with and advises district construction engineers and engineering project managers on construction problems.

The ***Administrative Officer*** issues Notices of Award and Notices to Proceed, processes requests for subcontractor approval, and maintains files of project-related correspondence.

Materials Bureau

The Materials Bureau has several areas of responsibility directly related to construction functions. These include:

- designing asphalt, concrete and cement treated base mixes;
- performing tests that district labs do not have the equipment or capability to perform;
- performing independent assurance testing, quality control and materials certification;
- conducting lab inspections;
- developing materials policies and procedures;
- maintaining the Materials Manual to include current policies and procedures;
- maintaining and testing nuclear equipment;
- consulting and advising on construction problems related to materials, soils or geology.

Bridge Bureau

The Bridge Bureau assists construction by checking and approving fabrication drawings; maintaining current welding procedures; reviewing and approving modifications of structures during construction; and reviewing and consulting on procedures to repair damaged or defective bridge members.

Surveying and Mapping Section

The ***Registered Land Surveyor*** supervises and directs all legal land survey activities related to preconstruction and construction. The Surveyor prepares or reviews all legal land documents; consults with and advises field survey personnel on surveying problems and procedures; develops and recommends survey methods for construction and preliminary surveys; and trains field personnel.

Public Relations

The Department's policy regarding public records is discussed below, followed by PR situations commonly encountered on construction projects. These are referred to as:

- relations with the general public,
- relations with property owners,
- relations with the news media,
- relations with other public agencies,
- relations with utilities and railroads, and
- relations with contractors.

Public Records

The Federal Freedom of Information Act does not apply to the Montana Department of Transportation. However, the statutes of Montana give citizens the right to inspect and take copies of public writings of the state.

Citizens are free to inspect day-to-day correspondence, estimates, field notes, quantity calculations, test reports, materials certifications, inspection reports, field project diaries and other normal, written construction project information. Certain types of documents in certain situations may be excluded from the provisions of this law. Normally, such documents are not found at the project; if there is any doubt, consult the District Engineer/Administrator.

Public access must be kept in mind when writing correspondence, reports, and records. The information must be factual; any opinions expressed must be grounded on facts and supported with evidence. Avoid derogatory or speculative statements about individuals or companies. And don't use field diaries to express your personal opinions of individuals, policies, or procedures; diaries can be admitted as evidence in court.

Standard Policy

Many requests are for a relatively minor amount of information that can readily be located and shown to the interested party. In other cases, a substantial amount of information is requested, or the party is not sure what documents are needed. In these cases, the party should be asked to make the request in writing to document it for our records; the party should also be asked to allow sufficient time so the information can be made available with the least possible disruption to our normal operations.

The policy is to make files, plans, notebooks, etc., available at the location where these are normally maintained. *Under no circumstances may any material be removed from the room or office.* Copies can be made in either of two ways: Interested parties can bring their own copying equipment, or they can list the documents they wish copied. We will provide copies upon payment for our cost to make them, including clerical time as well as copy machine rates. If certified copies are requested, consult the Legal Division through the District Engineer/Administrator for the prescribed form and fee structure.

Policy for Legal Actions

Information requested as part of a contemplated or pending legal action falls into a different category, and the procedures are different. Again, consult the Legal Division through the District Engineer/ Administrator if there is any question that the information is being sought for this purpose.

The District Construction Engineer should be informed as soon as possible when there are requests for non-routine records or for records that relate to controversial matters.

Relations with the General Public

Handling a request or a complaint, in person, is your best opportunity to improve the image of the Department. Mishandling a request or a complaint always causes considerable damage. A few guidelines:

- Be patient and polite, even if the other person isn't. (*Especially* if the other person isn't.)
- Answer questions and provide information, but don't hesitate to say "I don't know." Either provide the appropriate Department telephone number, or write down the person's name and phone number, and the nature of the problem, and give it to your supervisor. *Whatever* you do, don't leave the problem unresolved. *You* might forget about it, but you can be sure the other person won't.
- Don't close the conversation until you're sure that the person is satisfied with your response.
- People just naturally want to know what's going on, particularly if what you're doing will affect their daily routines. Answering their questions is the key — along with courtesy, honesty, tact, knowledge, and understanding.

If you're helpful when a citizen tells you about a problem, you will probably never hear from that person again. But if you're less than polite, you're almost certain to generate a complaint.

Information given to the public should not be slanted or evasive. However, all highway employees are strongly cautioned not to give people information that is not their concern. Be courteous, help motorists through the project by giving directions to other highway routes, miles between towns, etc., but refer other requests involving policy matters to the District Engineer/Administrator.

Relations with Property Owners

Highway construction projects have the greatest impact on property owners adjacent to the project. Because the impact on them is so direct, they present probably the most important public relations responsibility.

If possible, both the Engineering Project Manager and the contractor's representative should meet with all adjacent property owners before beginning the work. These meetings have proven to be highly valuable in the past. Outline the work to be done and how it will affect the landowners, and assure them that every effort will be made to hold nuisances and inconveniences to the minimum. Leave your name, office location, and telephone number in case they have a problem once work is under way.

The property owner's interest is not always the same as the Department's. Complaints and problems are bound to happen. Here again, patience and courtesy pay off. A discussion on the ground, in person, is often helpful in coming to an agreement. Ask questions and do your best to understand the complaint or problem; often the *real* problem is something different from what you first hear.

Once you do understand the problem, explain your position clearly. Keep your explanation as non-technical as possible, using terms and examples the person can relate to. Avoid projecting an attitude of superior knowledge. And certainly avoid projecting an image of the Department as an impersonal organization, riding roughshod over individuals and the public without regard for their needs and desires.

Always try to answer complaints or problems on the spot. If you don't know the answer to a question, or if you need time to study a problem, admit it; don't try to bluff. "I don't know . . . but I'll find out" goes a long way toward improving your credibility when you do respond. Give the person an estimate of the amount of time you'll need and when to expect an answer. If people make requests that are definitely against policy, or that you don't have the authority to act on, let them know immediately. Tell them who to contact if they want to pursue it further, but don't pass the buck.

At times, people make totally unreasonable or impossible demands. These should be treated with courtesy but also firmness. On occasion a discussion may deteriorate to the point where you are personally insulted or otherwise verbally abused. You are not expected to listen to this. Usually it's best to remain calm and just walk away.

Relations with the News Media

Newspapers, radio, and television can be helpful when information must be conveyed to a large number of highway users. The policy on news releases is that the Districts cover local policy, local government, District construction and maintenance activities, and other positive local highway news. The Information Unit at Headquarters covers general administration policy, state government, Highway Commission meetings, bid lettings, public hearing notices, and other positive statewide news.

All news releases must be cleared through the District Engineer/Administrator. Any media contacts that appear likely to result in a significant story should also be reported to the District Engineer/ Administrator and the Information Unit. And if points of conflict are observed, which might develop into public controversies or misunderstandings, the District Engineer/Administrator should be notified so early news releases can inform the public of the facts.

The District Construction Engineer may want to contact the local media before the job begins, tell them how to get accurate information during the life of the contract, and invite them to a tour with the Engineering Project Manager. In turn, Engineering Project Managers are encouraged to build good working relationships with the public and the media. It is proper for Engineering Project Managers to show proposed projects to the media in the same way they show projects to prospective contractors.

The media may be interested in running stories when the job is started, when it's partially completed, and when it's finished. Information that affects the traveling public, such as temporary detours, is of special interest; it should be sent to the Information Unit for use in Construction Road Reports.

The Information Unit is also interested in any unique features being used in the contractor's work or by the engineering crew. This can be good material for general-interest, statewide news releases.

Relations with Other Government Agencies

Federal, state, and local governmental agencies are often indirectly involved in our construction projects. This involvement comes about through various agreements between these agencies and the Department of Transportation — to secure funds, to share the costs of projects, use government lands, and to comply with various laws and regulations.

It must be recognized that these other agencies have an interest in our construction projects. In some cases, they have the authority to withdraw participation or take other actions to delay the work. Most problems can be avoided by personal contact and by maintaining a good working relationship with their local representatives at the project level. An effort should be made to explain the work and keep them informed of progress. Their questions and problems should be answered promptly.

Occasionally, they may request something that is not covered in the agreement, or which is contrary to our policies. In these cases, refer them to the District Engineer/Administrator.

Federal Government

We receive federal funds for many projects through an agreement with the Federal Highway Administration, FHWA. This gives them the right to inspect our projects and to ensure that they are being completed according to the approved plans and specifications, and in compliance with regulations. The FHWA must also approve change orders, work orders and other contract modifications. Their procedures vary to some degree, depending on whether the project is Interstate or NHS, or if it is on the other systems and covered by Stewardship Agreement.

It is essential that good working relationships be maintained with the FHWA at all levels. They should be provided with the assistance necessary to carry out their inspections. Project information related to quality of work and and contract administration should be provided as requested. FHWA personnel should be accompanied on their inspections by the engineering project manager or someone familiar with the work. Their advice and suggestions on problems should be solicited.

Remember that the FHWA is not a party to the contract between the State of Montana and the contractor. We inspect the work to enforce the terms of the contract; the FHWA inspects it to determine how well *we* are doing.

We frequently work with the Forest Service during construction, particularly in the western part of the state. Their involvement comes through agreements made to secure use of forest lands. The local office of the Forest Service should be contacted and given the location and telephone number of the project office. Offer to take them over the project or to accompany them when they review it. Keep them informed of work under way and its progress. Similar relationships should be maintained on projects coordinated with the Bureau of Land Management, the National Park Service, U.S. Fish and Wildlife Service, Corps of Engineers, Bureau of Reclamation, and Federal Power Commission.

Other State Agencies

The Department of Fish, Wildlife and Parks (DFWP) has an interest in our construction projects in or near streams because of state statutes giving them authority to review public agency plans for such work. The relationship between the DFWP and the MDT has been formalized in a Memorandum of Understanding signed by the Directors of the two agencies. Details of specific agreements between the two agencies for a particular project are contained in a Memorandum of Agreement and Approval.

Changes found necessary during construction must be accomplished through procedures established in the Memorandum of Understanding. They cannot be handled informally at the project level with local DFWP representatives. It is a good practice, however, to establish contacts with the local DFWP representatives and to keep them informed of progress and work under way.

The Department of State Lands administers reclamation of materials sources.

The Department of Environmental Quality issues permits related to air and water quality. These permits are issued to the contractor; DEQ deals directly with the contractor.

Local Governments and Agencies

Counties and cities often have an interest in or share the costs of constructing our projects. In these cases, there is an agreement between them and the Department. This forms the basis of the relationship between them and the Department.

Again, the proper officials of these agencies should be contacted in person. The work should be explained. They should be informed of progress and work under way. Offer to show the project and explain it.

These officials may request something that is not covered in the agreement, or a difference of opinion may arise. First, make sure you understand the problem. Then explain your position on it. If it involves something beyond your authority, refer them to the District Engineer/Administrator.

Relations with Utilities and Railroads

Our projects are often constructed over or within railroad rights of way, and utilities often must be relocated, crossed or disturbed during construction. In these cases we enter into agreements with the companies involved. The relationships between the Department and these companies are generally defined in the agreement.

Again, many problems can be avoided by personal contact and establishing a good working relationship with their local representatives. Keep them informed on progress of work that affects their facilities. Any questions or problems that develop must be resolved promptly. If you don't know the answer, tell them so and try to *get* the answer as soon as possible. If you don't have the authority to act on the matter, tell them so and refer them to the proper person in the Department.

Relations with the Contractor

Dealings with the contractor aren't public relations in the usual sense. The formal rules for relationships between the Department and the contractor are written into the contract, and the rules must be followed. This section of the manual is concerned with *how* the rules are followed.

The working relationship between the Engineering Project Manager and the contractor is one of the most important factors in completing a project. It directly affects the progress and quality of the work. A good working relationship expedites completion and promotes high-quality work, while a poor working relationship often results in delays and substandard performance.

General Principles

There are no hard-and-fast rules that will cover every situation that may be encountered, but there are some basic principles that can be applied in most cases.

The most critical is to *establish and maintain communications* with the contractor. Problems and disputes often become blown out of proportion simply because the two parties are not communicating.

Recognize that the contractor's and the Department's interests in a project are not necessarily the same. The contractor's primary interest is in earning a profit. The Department's is in obtaining the quality specified in the contract and in opening the facility to the public as soon as possible. These interests are bound to conflict at times. This is not a reason to automatically take a hard-line, adversarial approach in all relations with the contractor. Most disputes and problems are resolved through discussion and understanding.

Disputes should be resolved as soon as possible because they tend to become bigger with time. Don't take them personally; keep them on an objective, businesslike basis. And once they're resolved, forget them.

Consistent administration of the contract is another important factor in relations with the contractor. Inconsistency leads to confusion, misunderstandings, and hard feelings. It also gives the impression that you're not sure of what you are doing. This is important District-wide and statewide, as well as within a specific project.

The manner in which decisions are made also has an impact on relations with the contractor. *Timeliness* is essential, but don't be rushed into bad decisions. Take the time necessary to study and understand the problem, but don't use this as an excuse to delay the decision, hoping the problem will go away. Don't try to bluff your way through a problem if you don't know the answer. Don't be afraid to seek help. The same problem has been faced before by someone, somewhere in the Department.

The contractor is required to have a superintendent on the work site at all times. When it is necessary to issue instructions or directions to the contractor, they must be issued to the superintendent. Never issue orders or instructions to workers and never tell them how to operate equipment or do the work.

We often have contact with subcontractors and suppliers. We do not have a contract with them; our contract is with the prime contractor. The prime contractor is responsible for the work of all subcontractors and suppliers. We must not deal directly with a subcontractor or supplier on matters that

involve payment, or which significantly affect the work in any way. The prime contractor is responsible for scheduling their work and paying for it. We should avoid becoming involved in relations or disputes over scheduling or payment between the two.

Make sure that inspectors, and especially newer employees, understand (1) what their authority is, (2) how to *use* their authority, and (3) the channels of communications. Before major operations such as paving, it's a good practice to hold a meeting between the contractor's key personnel and the inspectors, to go over these points.

Avoid using sarcasm in discussions with the contractor. Avoid running down their work, equipment or operations to their employees or others. Don't wait for contractors to get into an impossible situation, then tell them about it. Rework is demoralizing, and it seldom turns out as well as a job done properly the first time.

At times it's necessary to disagree with a contractor, and even to take a completely opposite opinion. This calls for firmness, courtesy, and understanding. A few of the right words can take much of the sting out. Avoid giving the impression that you won and they lost this time. This can lead to a game that only results in hard feelings, delays, and low-quality work.

Code of Ethics

Department employees are subject to the State Code of Ethics in their off-project relationships with contractors. The Code generally prohibits:

- accepting gifts or gratuities of substantial value, or loans.
- contractors purchasing or leasing equipment, supplies or materials either through Department employees or *for* employees.
- dual employment, either on a full- or part-time basis.

Communications

General Correspondence

Routing and Distribution — Internal

Changes in policy and procedures, directives, and other information from the Construction Bureau are sent to the District Engineer/Administrator. Each district is responsible for distributing correspondence to field and other affected personnel.

All letters and memos directed to Helena from field offices are to be sent through the appropriate district office.

Materials reports, shop drawings, transmittals, change orders, and estimates are transmitted according to established procedures for those items.

Contractor Correspondence

Correspondence to contractors should be brief, factual, and address only the issue or question involved. It should tell what is required, answer questions, cite specifications, plans, etc. Don't get into detailed reasoning.

All correspondence should be directed to the prime contractor. Copies can be sent to subcontractors when replying to sub's letter, request, etc.

Engineering Project Managers should follow district policy for letters to contractor. Use standard State letter format.

Letters written to contractors and other parties should contain the specific details about events: dates, times, quantities, circumstances, references to previous correspondence or conversations and, where applicable, the names and titles of individuals involved in the events. The letter format on the next page serves as an example.

January 1, 1990

Name (no courtesy title)
Organization (no abbreviation)
P.O. Box/Street Address
City, ST Zip Code

Subject: Simplified Letter Format (adapted for MDOT)

Simplified Letter Format

```
Xxxxxxxxxxxxxxxxxxx (maximum 20 words) xxxxxxxxxxxxxxxxxx.

Xxxx (maximum 6 lines each paragraph – lists may be longer) xxxxx xxxx
xxxxxxx xxxxxxxxxxx xxxxxxxxx xxxxxxxxxxxxxxxx xxxxxxxxx xxxxxxx. Xxxx
xxxx xxxx xxxxxxx xxxxxxxxxx xxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxx.
Xxxxxxxxx xxxx xx xxxxxxx xxxxxxxxxxxx xxxxxxxx xxxxxxxxx xxxxx xxxxx
xxxxxxxxxx.

Xxxxxxxxx (maximum 3 main paragraphs) xxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxx
xxxxxxx xxxxxxxxxxxxxxxxxxxxx. xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx.

Xxxxxxxxxxxxxx (text is rag right – not flush right) xxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxx.  Xxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxx xxxxxx
xxxxxxxxxxxx.  Xxxxxxxxxxxxxx xxxxxxxxxxxx xxxxxxx xxxxxxx xxxxxxx xxx
xxxxxxxxx.

Xxxxxxxxxxxxx (maximum 20 words) xxxxxxxxxxxxxxx.  Xxxxxxx xxxxxx xxxx
xxxxxxxx.


Signature
Name and Title (typed)
phone number and extension

word processing code
enclosure/attachment

cc:
```

Anyone who has a legitimate interest in the letter should be sent a copy, with their names listed under cc:.

Procedures for writing memos should be in accordance with District policy. A definite system should be established to suit the particular needs of each District. Letters from the Engineering Project Manager to the contractor should have copies sent to the District Construction Engineer.

Signatures on Documents

Department employees frequently sign documents on behalf of their supervisors. The procedure for doing this should be uniform throughout the state, particularly for disbursement documents and other official documents. The following procedures are established for uniformity:

1. Supervisory personnel should designate one or more responsible employees (as required by circumstances) to sign on their behalf during absences. A memorandum to this effect should be sent to the Centralized Services Division as official evidence of the authority for such signatures.
2. These designated employees should sign their own names to the documents — rather than signing the supervisor's name and adding their own initials.
3. Where the supervisor's name or title is printed on the document, employees should sign their own names, with the word "for" preceding the printed name or title of the supervisor. Example:

/s/ James Smith
for Thomas Jones
District Engineer

The above procedures apply to matters dealing with fiscal involvement such as FHWA documents, vendors' claims, and personal expense claims.

Signatures on Routine Correspondence

The methods for handling signatures on correspondence will be left to the discretion of the supervisor involved. It is necessary, however, that the signature area show the name and title of the supervisor rather than of the employee signing the correspondence.

Telephone

Telephone calls should follow the same channels as correspondence. The Engineering Project Manager should never routinely call directly to the Helena office unless requested to do so or unless job conditions demand urgent attention and the District Construction Supervisor and District Engineer/ Administrator are unavailable.

Facsimile

The Department has facsimile (fax) machines in key offices in Helena and in the districts. In Helena, fax machines are located in accounting, communications, materials, central stores, and the highway patrol. Fax machines in the districts are in the following offices:

- Billings
- Bozeman
- Butte
- Glendive
- Kalispell
- Lewistown
- Miles City
- Missoula
- Wolf Point
- Great Falls
- Havre

Refer to the current Montana Department of Transportation Statewide Telephone Directory for the current fax numbers.

The use of faxes is particularly appropriate where information must be transmitted quickly; and they're cost effective for one- or two-page documents, even when fast delivery is not important. Documents 8-1/2 inches wide, of essentially any length, can be faxed. Fax machines will self-feed up to ten sheets. Additional sheets require hand feeding or must be sent in separate transmissions.

Low-density dot matrix print will not transmit well on fax machines. It's usually best to make a photocopy, adjusting the copier for high contrast.

The print on thermal fax paper turns black and becomes unreadable if it's left exposed to light. If documents must be used in sunlight or be retained indefinitely, make photocopies.

Modems

The Department's Personal Computer Construction Management System (PCCMS) allows field, district and headquarters (Helena) construction personnel to enter information for progress estimates and change orders on a personal computer and transmit the data through modems to update the mainframe Progress Estimate System Files. PCCMS can also be used to communicate between PCs. The program is menu driven; users should refer to the manual for PCCMS for detailed instructions.

We also have E.D.D. This is a method of sending letters from word processors in the districts to Helena, and vice versa. This is a useful tool.

Progress Estimates

Engineering project managers have PCs in their offices and enter the estimate data and transmit it to the districts. The districts review the information and send it on to Helena, where it is used for contractor payment. Engineering project managers who do not have access to PCs must call the estimate data into the district office, where it is entered and transmitted to Helena.

When the estimate is paid, Helena transmits the estimate back to the district. The district, in turn, transmits the estimate to the project manager for use in preparing the next estimate.

Change Orders

Engineering project managers have PCs available and develop change orders directly on the computer and transmit them to the district for approval or disapproval. Approved change orders are transmitted to Helena by the districts. Copies of the Helena-approved change orders are then transmitted back to the districts through use of modems.

Engineering Project Managers without access to a PC must complete the change order manually and submit the hard copy to the district for approval and transmission to Helena.

Radio

A network of radio stations has been established to provide radio communications throughout the State.

Radio communications should follow established procedures.

Chapter Two

Contract Administration

Scope of the Work
(104)

The construction contract provides detailed instructions through the use of the plans, specifications and drawings. Where doubt or disagreement exists as to the intention of the plans or specifications, the engineering project manager is to provide interpretation or decide questions. Any situation that can not be resolved at the project level should be directed to the District Construction Engineer.

Changes
(104.02)

Project personnel should expect to encounter conditions from time to time that were not anticipated during the planning process. These conditions may or may not require changes to the contract and fall into two broad categories: minor and major.

Minor Changes

Minor changes such as widening ditches, flattening slopes, small changes in lengths of pipe or guardrail, minor changes in location of pipe or guardrail, do not require any changes to the contract. Any overruns for these situations should be paid for as they occur and explained with a note on the progress and final estimates.

Major Changes

Major changes include work and materials that were not addressed in the original contract, or significant alteration of the original quantity estimates. Major changes must be documented and approved through the use of supplemental agreements, change orders, or extra work orders.

Changes Proposed by the Contractor

Proposed changes should be carefully considered and evaluated from the standpoint of the contractor's ability to complete the work on time. This is especially important as the project nears its completion date. Late changes can not only add to the cost of the work, but can also release the contractor from liquidated damages.

When a proposed change is reasonable, the State should benefit from any money savings that is realized by the contractor. When a value engineering clause is included in the contract, any cost-reducing changes proposed by the contractor must be submitted in accordance with the stipulations of that provision.

Change Orders
(104.02.4)

After a contract has been awarded, any change in the plans, specifications, or both are generally discouraged unless the change meets one or more of the following criteria:

1. It is clearly impossible to construct in accordance with the plans or specifications.
2. It is clearly in the public interest to make the change because a superior product will be obtained at no extra cost.
3. It is clearly in the public interest to make the change because the same product can be obtained at a substantial savings to the State.

Conditions Requiring a Change Order

- Changes in the geometric design (alignment and/or grade) of the main line roadway, ramps, and frontage roads other than typical minor project construction changes which do not affect sight distance, design speed, other operational characteristics, or change the nature of the work.
- Changes in typical sections other than typical minor project construction changes which do not reduce layer thickness, otherwise affect structural capacity or change the nature of the work.
- Additions, deletions, relocations of bridges and/or other structures.
- Deviation from the existing access control.
- Changes in the specifications, special provisions, or other contract requirements.
- Departure from approved standards.
- Changes that require agreed unit prices.
- Changes in any environmental feature of design or construction which change the work and require approval from another agency.

- Contractor claims settlements.
- Changes in the scope of the work.
- Accepted V.E. proposals.

For Changes in Quantities, a Change Order is Required:

- When a major contract bid item increases or decreases 25 percent.
- When a non-major item underrun or overrun exceeds $50,000 in cost except that this amount can be exceeded for traffic control items if acceptable to both the District Engineer/Administrator and Construction Engineer.
- When the engineer determines a fair and equitable adjustment in the contract unit price and is warranted under Article 104.02.3 as a result of a significant change.
- When the Engineer considers a change order to be in the best interest of the Department.
- If a change order is submitted for an item overrun or underrun, then the associated items should be included on the change order, i.e., plant mix surfacing, asphalt.
- Change orders should not be submitted as a substitute for explanatory notes or to document funding split adjustments. Funding split adjustments should be submitted by memo to the Construction Bureau. Required change orders should show proper funding splits.

Impending overruns in watering, rolling, culverts, bituminous materials and surfacing items should be estimated and a change order prepared well in advance of the completion of the items involved. Do not wait for the final estimate before sending a change order to cover these overruns.

In isolated instances, it is impossible to estimate the overrun until the item has been completed. In such cases, it is permissible to submit the change order after the work is done, provided that the problem has been previously discussed with the appropriate individuals or prior approval has been obtained. Written notice should be sent to the Construction Bureau advising of the impending overrun. Examples of items that may fall in the above category are: Culvert extensions, deletions, substitutions, culvert excavation, manhole adjustments, valve boxes, foundation piling, etc.

Change Order to Accept Work at a Reduced Price

Occasionally, a contractor will do work or provide a product that does not meet all of the contract requirements, but can be accepted at a reduced price. If continuous honest attempts have been made to meet specification requirements, and documentation verifies those attempts, a price adjustment may be made by change order. Prior to issuing the change order, a detailed review of the facts must be made by field and headquarters personnel. The contractor must also submit a written request for acceptance of the work or product at a reduced price.

Preparation of Change Orders and Extra Work Orders

These documents must be prepared with careful attention toward clarity, conciseness and accuracy and should be written in such a manner that a person who is unfamiliar with the project is able to understand what the work entails.

Change orders and extra work orders are directives from the State to the contractor for the performance of certain work; as such, they must be specific. Do not use indefinite terms such as "It is proposed to" or "It is recommended that"; simply state that the work shall be done.

Change orders and extra work orders should be limited specifically to ordering and describing the intended work and stating the method of payment. It is seldom necessary and generally undesirable to explain the reason for the extra or additional work in the work description frame. This information should normally be included as an attachment.

Occasionally, the basis for performing extra or additional work is in accordance with a standard or supplemental specification. If this is the case, a statement of that fact should be included with the submittal, such as: "This work is being accomplished under the provisions of Article 104.05 Special Maintenance."

When a contract contains more than one project, all change orders and extra work orders must be handled as they pertain to the project involved rather than the overall work under the contract. The project number, change order or extra work order number and other details of the heading must be complete and accurate. Change orders and extra work orders must each carry their own number sequence for each individual project. Once a number has been assigned, it is to remain permanently with that particular change order, or extra work order, even if the document becomes void.

Contract Time Extensions
(108.07.4)

Due to the wide variety of situations that may be encountered, all extensions should be discussed with the contractor prior to preparing the change order or extra work order.

The contract time should be increased proportionally when it is necessary to perform extra or additional work. Time extensions can be based on either the money value of the work or the estimated length of time required for completion. Time extensions by the "Money Formula" are outlined in Article 108.07.4 of the Standard Specifications. This formula should be used as a guide in determining the additional time that will be allowed. A time extension may sometimes be more than the amount computed by the Money Formula, but it must never be less. The Money Formula normally does not result in a reasonable time allowance for calendar date projects.

Sometimes extra or additional work must be done which requires more time than would be allowed by the Money Formula. When additional time can be justified, it should be granted. If a time extension is allowed that exceeds the number of days indicated by the Money Formula, the reasons for the allowance of additional time must be explained in the change order or extra work order. The impact of the extra or additional work on the contractor's total operation must be considered when evaluating an extension based on the length of time required to perform that work. Extra or additional work frequently requires more time to complete than would be allowed by the Money Formula; however, if the contractor is using only a fraction of the total work force, allowance of the full amount of time expended on the work would not be justified.

Example: Extra work is to be accomplished by change order at agreed prices. The Money Formula would allow a seven-day extension of contract time. It is estimated that 14 days will actually be required to do the work and approximately 40 percent of the contractor's work force will be used. Since 40 percent of 14 equals 5.6, or 6.0 when rounded to the nearest whole day, then the seven-day extension allowed by the Money Formula would be reasonable.

Submittal Procedure

Send all change orders and extra work orders to Helena for review and processing, regardless of the money amount. Submit the original to the Construction Bureau, along with one copy of all pertinent supporting data. The contractor, District Construction Engineer and District Engineer/Administrator must sign all change orders and extra work orders. Those reflecting increases or decreases in excess of $10,000 will require Construction Bureau approval. Written approval from the FHWA will be obtained by the Construction Bureau, when necessary.

All change orders and extra work orders must be thoroughly checked to ensure:

- Headings are complete and accurate.
- All computations and cost extensions are correct.
- Contract time extensions are shown and reasonable.
- Work descriptions are concise and intelligible.
- All necessary documentation is attached.
- All appropriate signatures have been obtained.

Use black ink for signatures because it reproduces more clearly than other colors. For the same reason typing should be dark and of good quality.

The Construction Bureau will distribute approved change orders and extra work orders to the appropriate parties. The original will be retained in Helena for the permanent project file. Reference copies should be kept by the Engineering Project Manager until the finalized copy is received.

Change Order Approval

Normal Method. All change orders and extra work orders involving a total contract increase or decrease of more than $10,000, and all change orders reflecting individual item increases or decreases which exceed $10,000, must be approved by the Construction Bureau. Extra work orders and change orders under the $10,000 limit, as defined above, will be approved by the District Engineer/Administrator.

Federal Highway Administration approval is also necessary for all change orders and extra work orders that are not covered by the State/FHWA Stewardship Agreement. In general, this agreement includes all projects except interstate and National Highway System (NHS).

All proposed change orders and extra work orders over $10,000 must be discussed with the Construction Bureau when their need becomes apparent. Discussions dates and the names of the State and Federal personnel with whom discussed must be noted at the bottom of the work description frame. It is the responsibility of the District to ensure that all change orders and extra work orders have been discussed with the FHWA.

With the exception of emergency situations, the contractor must not be allowed to begin extra work without written authorization.

Prior (Advance) Approval. Prior approval for change orders and extra work orders under $10,000 will be issued by the District Engineer/Administrator. On partnered projects this limit is $100,000.

The issuance of prior approval shall be limited to work that is of an urgent nature. To be considered urgent, the work must be unexpected and require immediate attention.

The following example situations would warrant a request for prior approval:

- There is an immediate danger to the adjacent residents or the general public.
- Delay in accomplishing the work may result in damage to the project or adjacent property.
- Completion of a major portion of the contract is contingent upon the work being done and a delay in approval would cause a serious curtailment of the contractor's operations.

Requests to the Construction Bureau for prior approval are to be made by fax or electronic mail. Be sure to state the problem encountered, the suggested solution, description of the intended work, estimated quantities and expected costs. Telephone discussions may be necessary to clarify various aspects of the work; however, the actual request and prior approval are to be documented. When necessary, the Construction Bureau will obtain prior approval from the FHWA.

The Districts are responsible for obtaining prior approval from the FHWA for extra work orders and change orders when required. All prior approvals by the District Engineer/Administrator should be documented in writing.

The date that prior approval was issued and the name of the person granting approval must be shown in the lower portion of the work description frame of the extra work order or change order.

When prior approval is granted, the contractor is to be given written authorization to proceed with the work. The basis of payment must also be stipulated in the letter (contract prices, agreed prices or force account).

Basis of Payment
(109.04)

Work accomplished by change order will be paid either at contract bid price or agreed price.

Contract Bid Price. When additional work is required that can be adequately covered by contract bid items, payment is to be made at the applicable unit prices, unless other circumstances exist which render the contract prices inappropriate.

Agreed Unit Price (Work by Agreement). The work by agreement change order is a method of accomplishing extra work without the detailed documentation and record keeping required with force account work. The documentation to justify agreed prices should be kept as simple as possible without jeopardizing our control over the cost.

The acceptability of an agreed price may be based on favorable comparison with a previously established price for the same item or an independent cost estimate compiled by the Engineering Project Manager. Previously established prices may be from the tabulation of average low bid prices which is issued semi-annually by the Department, the cost of similar work in recently let projects or the cost for past extra work.

Caution must be exercised in choosing a standard of comparison for an agreed price item to ensure that it is a true representation of that item's worth. For example, if a previously established price is being considered as the basis of payment for extra work, closer examination of that price would be necessary if it represents only a small quantity or the work was accomplished under abnormal conditions.

If the contractor's proposed price is excessive, when compared with a previously established price, further justification is required. The additional justification can be anything that will satisfactorily explain the reason for the higher price. When special problems are involved that would cause increased expenses to the contractor, a statement directing attention to those problems may be adequate justification.

When work is involved for which a basis of comparison cannot be established, a detailed cost estimate may be used. This estimate may be prepared by either the contractor or the Engineering Project Manager. If the contractor's estimate is used, the cost is to be verified by the Engineering Project Manager and the change order must contain a statement that the price is supported by the District.

Assign each agreed price item an item number, reflecting the change order number and the sequence in which the item appears in the change order, beginning with the number 01 for each change order.

Example: The first agreed price item in change order number 3 would be assigned Item No. CO-03-01, the second agreed price item CO-03-02, etc.

Once a number has been established for an agreed price item, this number must be used to designate the same item on all future change orders for that project.

Extra Work Orders (Force Account Work)

General

An example of a completed extra work order is included at the end of this section, and may be used as a guide in preparing extra work orders. Should non-typical and unfamiliar circumstances arise, which are not adequately covered in this manual, contact the Construction Bureau for any assistance necessary in preparing the extra work order.

Extra work performed by a contractor without written approval from the State is unauthorized work and should not be accepted or paid for, except under an emergency situation when verbal prior approval has been granted.

Do not use an extra work order (Form CB-12) as an agreement to perform railroad or utility work. Extra work orders allow certain surcharges which are not applicable to railroad and utility work.

The total estimated costs for material, labor and equipment are to be listed individually on the extra work order form. Attach worksheets containing a summarized breakdown of the estimated costs to the work order. The worksheets need not be formal and may be done in any manner that is convenient, as long as they contain sufficient detail to indicate how the totals were determined. Printed worksheet forms are available from the Construction Bureau, but their use is not mandatory.

The cost of potential force account work is to be estimated by the Engineering Project Manager. It is generally advisable to confer with the contractor's superintendent in order to arrive at the most meaningful estimate. The practice of requiring a detailed cost estimate from the contractor should be avoided. Because early submittal of extra work orders is extremely important to ensure approval in a timely manner, the cost estimates are to be prepared from the best sources available at the time. When

preparing extra work orders, it should be kept in mind that the costs shown are merely estimates and as such are expected to vary somewhat from the final costs.

Work Methods

The Engineering Project Manager has the authority at all times during force account work to direct the contractor's operations. Normally, the contractor is allowed to select the method by which the work will be accomplished, provided it results in a reasonably effective operation. When the contractor's methods are clearly inefficient, the Engineering Project Manager should require that appropriate corrective measures be taken. Caution must be exercised when making a judgment as to the efficiency of an operation in order to guard against making an issue over borderline situations.

Occasionally, extra work will be of such a nature that it must be done in accordance with a prescribed procedure. In those cases, the method will be specified by the Engineering Project Manager.

Estimates

Materials. The Engineering Project Manager determines the materials that will be required and estimates the quantities. The prices for the materials should be established from known costs or price quotes from suppliers. Supplier price quotes need not be formal and may be obtained by telephone. Do not include materials invoices with the extra work order. These documents should remain in the project file for submittal with the final. Estimates for materials costs will be invoice cost plus fifteen percent.

Labor. Labor cost estimates must be broken down by worker classification. A supervisor's time may be included, but only if that person actually takes part in the work. Estimates for labor will include the labor rates plus the eighty percent markup as a minimum. See Article 109.04.2 (A) Labor.

Equipment. The Engineering Project Manager is to determine the equipment that will be necessary to perform the work and estimate the number of hours for each unit. It is generally not known at that time what equipment will actually be used; therefore, an excessive amount of time and effort should not be spent trying to make type and size determinations. For example: If it appears that a 1-1/2 cubic yard backhoe will be required, an average priced 1-1/2 cubic yard backhoe should be selected from the Blue Book.

Sufficient information must be shown on the cost estimate work sheets to designate where the price for each unit was obtained. If the Department's Equipment Rental Rate Guidelines is used, list the section, page and code number. When a particular piece of equipment is not shown in the Guidelines, indicate how the rate was derived. If the contractor intends to rent some or all of the equipment, an informal rate quote from the rental agency is satisfactory. Do not submit Equipment Rental Rate Determination forms with the extra work order.

Normally, the operator's time will be the same as the machine's time. Occasionally, charges for standby time will be acceptable when it is absolutely necessary. However, these charges should always be kept to a minimum.

Progress Payments

Payment for extra work is to be made on the monthly estimate representing the time period in which the work was actually accomplished. Progress payments are to be made on the basis of Statements of Daily Force Account Work, Form CNS-12.

Statements of Daily Force Account Work (Form CNS-12). All phases of force account work are to be recorded daily on Form CNS-12 and verified by signature of both the State inspector and the contractor's representative.

Materials and Labor. Payments made for materials and labor are made on the same basis as the estimate.

Equipment. The total hourly rate for each piece of equipment, without operator, is equal to its bare hourly rate times the Montana adjustment factor, plus its hourly operating rate.

Bare Hourly Rate: The bare monthly rate from the Rate Guidelines for a unit of equipment, including all attachments and accessories that are actually used in the work, divided by 176. The bare rate represents fixed ownership costs such as depreciation, repairs, insurance, taxes, etc.

Montana Adjustment Factor: The regional Blue Book adjustment factor for Montana. This factor differs to some extent from one equipment category to another and is to be applied to the bare rate only. The adjustment factor represents the difference between Montana and the national average for labor costs, freight charges, taxes, construction seasons, etc.

Operating Rate: The hourly operating rate from the Blue Book for a unit of equipment, including all attachments and accessories that are actually used in the work. The operating rate is intended to cover the cost of fuel, oil, lubricants, general maintenance, etc.

When a specific model or type of equipment is not listed in the Blue Book, a rental rate determination should be requested from the Construction Bureau. All available information on the machine should be supplied with the request.

When allowed, equipment standby time will be paid at 50 percent of the ~~total~~ BASE hourly rate. Payment for standby time may not exceed eight hours per day or 40 hours per week.

Payment for equipment rental will be to the nearest one-half hour, but not less than one hour per day.

Equipment required for the work, but not available on the project, will be allowed reasonable move-in/move-out expenses. Move-out expenses are not reimbursable when the equipment is used on the project for other work. In no case will the move-out expenses exceed those for the move-in.

The contractor will be paid transportation costs for equipment that is hauled to the worksite. The total hourly rate applicable to the hauling unit will be paid for the time the equipment is in transit. Expenses for equipment transported by commercial hauler will be paid at invoice price. Equipment hauled to the project will be allowed the standby rate for time in transit. Equipment moved to the project under its own power will receive 75 percent of the total hourly rate for move-in and move-out time.

Commercial rental equipment may be authorized for use if the contractor is unable to obtain the required machine from normal sources, or if it is less expensive than mobilizing the contractor's equipment. When the use of commercial rental equipment is approved, a reasonable rate plus 10 percent will be paid. The rate must be agreed upon and approved by the Construction Bureau in advance of the equipment's use. The agreed upon rate must be documented by invoice from the rental agency.

An Equipment Rental Rate Determination form must be completed for each piece of equipment involved in the force account work and submitted with the final.

Items such as burner fuel, ripper teeth, sharpening costs, etc. are to be treated as force account materials; payment shall be at invoice prices, plus 15 percent.

Contract Claims Procedure

(105.16)

General Policy

Contractor claims are to be resolved at the earliest stage and lowest level possible. District Engineers/ Administrators have the responsibility and authority to investigate, review, evaluate and decide contractor claims.

The FHWA is to be promptly provided with copies of written claim notices where federal participation is involved. The FHWA will be informed on progress to resolve such claims.

Claims, and notices of claims, will be accepted only from the contractor. Claims directly from subcontractors will not be accepted, but claims originating with a subcontractor and submitted by the prime contractor may be accepted.

Procedures for Processing
(105.16.1)

The Notice of Potential Claim Form will be furnished to the contractor on request. The Engineering Project Manager is to note on the form the date and time it is received.

Copies of the completed form are to be transmitted to the District Construction Engineer. The District Construction Engineer will give copies to the District Engineer/Administrator and the Construction Bureau.

Verification of Costs
(105.16.2)

TheEngineering Project Manager is responsible for verifying the contractor's cost records. Questions to consider include: Was a certain piece of equipment on the project on a certain date? Was it operating or broken down? How many men were working in the claim area? A photo history is suggested as a good means of recording progress and equipment in use, as well as conditions. Periodic aerial photography should be considered in cases of major claims.

The contractor is required to update and submit cost records every 30 days until the claim is complete. These are to be checked against project records as they are received. Any apparent discrepancies will be noted and recorded.

Claim Settlements
(105.16.3)

Any claim settlements will be implemented by change order, following established procedures. Settlements made after the work is complete are to be identified as claim settlements.

Claim settlements are to be discussed with the FHWA when federal participation is involved.

Administrative Costs

Costs of audits in connection with claim review and settlement are eligible for federal participation on a basis other than construction engineering. Audit in this sense means technical or regular audit examination of contractor records. The Construction Bureau should be contacted in the event it appears there will be significant costs of this type involved in a particular claim.

Maintenance of the Work
(104.05)

There are many types of maintenance listed in the Standard Specifications; however, the specific work to be done will be determined by the Engineering Project Manager.

The Engineering Project Manager must frequently review the project to be sure that necessary maintenance is being done, and if it is not, to insist that the contractor perform it.

Special Maintenance

Special maintenance work may be specifically addressed in the special provisions, or may be required by causes not under the contractor's control, such as floods, slides, etc.

Payment for special maintenance can be at unit prices, but more often it is done by force account. In order to ensure federal participation, it is essential that proper force account documentation be kept from the beginning of work.

Maintenance of Traffic During Suspension of Work
(104.05.4)

Periodic reviews should be made by the Engineering Project Manager during the suspension to ensure that the roadway is in a smooth and safe condition, and if not, the contractor should be contacted.

If work is continued during the winter months, the contractor is responsible for maintenance of that portion of the project being worked on or hauled over. If the work is being done off the PTW, such as crushing, then the State is responsible for maintenance.

Traffic Control
(104.05.5)

The project documents cover detours and construction signing in detail and should be carefully reviewed prior to establishing detours and signing for construction zones.

Use of Materials Found in the Work
(104.06)

Written authorization is required for excavation outside planned slope and grade lines and may be given only in cases where it benefits the State. Such authorization should in no way adversely affect the appearance or function of the planned project.

Should acceptable materials be found within the work which can be used for aggregate surfacing or similar items, the contractor may be allowed to use these materials under certain circumstances. However, this practice is not always desirable due to the possibility of royalty problems, changes in haul distance and poorly located borrow and waste areas. Many projects have exceptionally steep side slopes or wide ditches caused by contractors using unclassified excavation material for purposes other than planned and then making up the deficiency from roadside sources. Approval must be gained before any use of materials can be made that is contrary to the planned use.

Control of the Work
(105)

Authority of the Engineering Project Manager
(105.01)

The Engineering Project Manager is the chief inspector, and will decide all questions that may arise as to the quality and acceptability of materials and work performed and questions of interpretations of the plans and specifications. The Engineering Project Manager has authority to suspend, or not accept, any work that fails to comply with the contract requirements. In case of doubt as to authority, the District Construction Engineer should be consulted.

The Engineering Project Manager must exercise this authority through the contractor's superintendent or designated representative. Orders should not be given to workers, subcontractors, or suppliers.

The Engineering Project Manager can offer suggestions to assist the contractor when there is a possibility the work could end up unacceptable. Care must be exercised so the suggestion is not interpreted as a direction when things go bad.

Important verbal and written communication is both given to and received from the contractor during the course of the project. Frequently a verbal order will need written confirmation. To help the Engineering Project Manager know what orders should be written and what section of the Standard Specifications contains instructions about an order, the following two-page list has been compiled. This list is not the last word, nor does it set out the only circumstances that may occur.

WRITTEN ORDERS TO AND FROM THE CONTRACTOR

Subject	*Section of Standard Specifications*
Contract Administration	
1. Various portions of bidding requirements, and award and execution	103
2. Contractor says project is complete, Contractor starts a claim, Name of superintendent	105.15.2 105.16.1 105.05
3. Withholding from estimate for landowner's back pay on materials	106.01.1
4. Contractor to tell of conflict with any law, all insurance requirements, close public roads	107.01 107.13 107.06
5. Notice to Proceed, Suspend and Resume Orders	108.02 108.03
6. Contractor wants more time, Wants semi-final estimate	108.07.4 109.08
7. Assignment of more than 60% of earnings, subcontracting, consent of surety	108.01.1
8. Neglect or default in contract terms, Termination of contract, Acceptance of work	108.09 108.10 109.08
9. Notice of any claim against contract and bond, release by State agency having claim	109.08
10. Contractor requests payment for materials on hand	109.07
11. Contractor files written complaint when error or omission is discovered	105.16.1
Contract Changes	
1. Increases or decreases in quantities, changes in planned construction details	104.02.3
2. Elimination of proposed work or contract items	104.02.3
3. Method of measurement, prior approval before doing extra work	109.01 104.03
4. Changes in elevation of structure footings	209.03.2
Contractor's Personnel and Equipment	
1. Engineer's request to remove workmen Contractor's request to use noncontractual equipment or methods	108.05 108.06
2. Alternate methods of loading batched aggregates and cement	551.03.3

Subject	*Article of Standard Specifications*
Control of Work	
1. Rights in and use of materials found on the work	104.06
2. Final clean-up of pit areas, contractor work areas	104.07
3. Directions to correct unsafe working conditions	105.01
4. Notices for correction of unacceptable work	105.12
5. Roadway maintenance and construction protection	104.05 203.03.5
6. Notification of blasting to utility companies	107.09
7. Owner's permission for shutting off irrigation water	104.05.6
8. Notification by contractor for permission to perform work at night, suspension or resumption of work, suspending work without permission	108.06
9. Notice to contractor of delay in work	108.09
10. Permits to burn grubbing debris	201.03.5
11. Permission to broadcast seeds	610.03.2(B)
12. Contractor to furnish reclamation plan	106.02.5(B)
13. Disposal areas	201.03.5
14. Prior approval to use curing compound	713.07.2
15. Detail drawings of falsework to engineer	552.03.3
16. Approval to place concrete under water	552.03.6
17. Permission from engineer to remove falsework	552.03.11
18. Permission to deviate from approved fabrication plans, notice to begin steel fabrication	553.03.2
19. Permission to leave timber bracing from cribs or cofferdams in substructure masonry	209.03.3
20. State approval of traffic signal and lighting details	617.03.2
21. State approval to abandon "in place" electrical equipment	617.03.14(A)
Control of Material	
1. Contractor's notice of selecting source for various materials, approval of materials through test reports, certificates, etc.	106.02.1 106.3
2. Permission to store materials on private property	106.07
3. Change in brand and type of cement	551.02.1(2)
4. Permission to use water or current reducing additives	551.02.3
5. Permission to hand mix concrete	551.03.3(E)
6. Permission to use admixtures for prestressed members	551.02.3
7. Permission to substitute structure elements	556.03.2

Contractor's Equipment, Personnel, and Operation
(108.04,.05,.06)

The Engineering Project Manager may at any time inspect the contractor's plant, equipment, and tools to ensure that they will produce work that complies with the specifications. The contractor should not be allowed to start work unless the equipment is adequate for the proposed use, and it must be maintained in good workable condition.

Approval of Subcontractors
(108.01.2)

The Engineering Project Manager should ensure that the subcontractor has been approved and an approved copy is in the project file or on the way. All notification, written memorandums, etc., that deal with the orders from the engineer to the subcontractor shall be directed through the prime contractor.

Lines and Grades and Bridge Survey
(105.08.1) and (105.08.2)

Unless otherwise provided in the contract, Department survey crews are responsible for setting construction stakes, establishing lines, slopes, continuous profile grade, and all such construction survey needs. The Engineering Project Manager will furnish the contractor with all necessary information relating to the lines, slopes, and grades. The contractor is then responsible for preserving the stakes and marks that have been set.

The subject of preserving the construction stakes that have been set should be thoroughly discussed in the preconstruction conference where the contractor can be informed of the cost of the work of replacing these stakes and the possible delay to work forces that may occur because of the necessary resurveying work that is to be done. In any construction work, the occasional destruction of a few stakes is almost impossible to prevent. The Engineering Project Manager should not become overly concerned about having to replace a few stakes.

The cost of replacement resulting from continual, willful, or careless destruction by the contractor of these lines and grades can be deducted from the cost of the work performed, and in some exceptional instances this may be the only way to bring the contractor's attention to willful disregard for the lines, slopes, and grade stakes that have been set.

Procedures for Checking Contractor Staking

Bluetops and Horizontal Line Control

Checking should be done by sampling a section of roadway. Sample points should be selected by a random method.

The contractor should be required to check and rework the entire section if an unacceptable number of points in the section are not within the specified tolerance. Payment should be withheld until the section is rechecked and found to be within tolerance.

At no time should Department forces check all or a large part of the contractor's stakes or reset any that are not in tolerance.

Each job is done differently so no attempt has been made to set section lengths, sampling frequencies, etc. The engineering project manager should set these according to the job conditions.

A greater number of points should be checked at the beginning of the contractor's staking operation. The prime contractor should be informed of problems discovered with the subcontractor's staking work.

A suggested procedure is to check a 1/2 mile section with 10 check points at start-up. The section would be considered acceptable if at least 8 of the 10 points were within tolerance. Later, if work is acceptable, this could be reduced to 5 check points, and considered acceptable if 4 out of 5 were within tolerance.

Inspection

(105.10) and (105.11)

The inspector should avoid giving specific instructions as to the operation or adjustment of equipment, the use of various construction methods, etc. Should such instructions be given and the quality of the work become deficient, the engineer can then be held responsible for the outcome of that work. If deficiencies are pointed out to the contractor's responsible representative and are not corrected promptly or assurance is not given that corrective action will be initiated, the inspector should take the matter up with the Engineering Project Manager and the contractor's superintendent. If necessary, the Engineering Project Manager should issue an order instructing the contractor in writing of the corrective action necessary to bring the deficient work items up to an acceptable standard. Before issuing instructions to correct defective work, the inspector should be sure that the judgment made is sound and fair. The decision should then be firmly supported and personality conflicts avoided.

In requesting the discharge of a contractor's employees who willfully and continuously act contrary to the engineer's instructions or otherwise conduct themselves in an improper manner, the project manager should first discuss this severe action with the contractor's superintendent and with the District

Construction Engineer, document the discussions, and then issue the written instructions to the contractor for the dismissal of the employee or employees involved.

Contractor's Superintendent
(105.05)

The contractor is required to have a representative on the project at all times and make that person known to the Engineering Project Manager. Inspectors should never have to chase through the whole project in an attempt to find an absent superintendent.

Final Inspection
(105.15.2)

When the project is substantially completed, the contractor may request a final inspection. If the Engineering Project Manager believes that the contract is substantially completed, final inspection is arranged through the District Construction Engineer. The District Construction Engineer will notify the FHWA Area Engineer and set the date for the final inspection. However, if the Engineering Project Manager doesn't believe the job is substantially completed, a check list should be made documenting any incomplete work. The items on the check list should be specific as to location and nature of the incomplete work. When the items on the check list have been completed to the satisfaction of the Engineering Project Manager, the District Construction Engineer should be contacted to arrange for the final inspection that had been previously requested by the contractor.

Control of Materials
(106)

Approval of Sources
(106.01.1)

The contractor must submit a list of the sources of supply for materials to be used in the work. The list must be submitted to the Helena Materials Division in time to make proper arrangements for early inspection and testing of the material listed. Materials which do not comply with specifications must be rejected and the contractor notified at the earliest opportunity so that materials can be obtained from other sources.

Material Inspection and Testing
(106.01.2) and (106.03)

Manufactured materials are tested and inspected at the source of supply, whenever this is practical. When materials are manufactured outside of the state of Montana, testing and inspection is handled under contracts with commercial testing laboratories and occasionally arrangements for testing are made with

other state highway departments. The Helena Materials Bureau is in charge of and responsible for arranging all such testing. Correspondence regarding materials to be tested by outside agencies is to be directed to the Materials Bureau, Helena. Inspectors or contracted testing agencies who are representatives of the State will have free entry at all times to those parts of plants which are engaged in the manufacture or production of materials for State work. Permission to use materials tested by commercial labs or by inspectors from the Helena Materials Bureau is received by the Engineering Project Manager through the Materials Bureau. Generally, these reports will be with the material when it arrives. No material should be used in the work until the Engineering Project Manager has received the reports and has reinspected the materials. However, the responsibility for incorporating adequate and satisfactory materials into the work rests entirely with the contractor. Occasionally, materials fabricated outside the state have been adequately tested, are correct and proper to use, and have been received on the job; however, the materials test report is not available to the Engineering Project Manager. In such cases when notification has been given, a certificate, memo, or fax may be prepared to alert the Engineering Project Manager that a test report has been received in the Helena Office and is on its way, that the materials are proper and may be installed, subject to final approval in the field.

The contractor is responsible to furnish materials lists, manufacturers' brochures, shop drawings and other necessary documents that certify a material's acceptability, especially in the case of standard manufactured products. Copies of all approved materials lists, manufacturers' brochures, shop drawings, on-site inspections for dimension and visible checks of materials used, and other such necessary certificates that will prove the materials used have truly been inspected and approved should be placed in the project files.

Often, the specifications or special provisions will use a trade name (or equal) to designate required products. The contractor then has the option of furnishing alternate articles or materials which are of equal or better quality to that which is specified. The burden of proof that the quality and suitability of the chosen alternate is equal to or better than the specified item is entirely up to the contractor. Any information required or necessary to determine its suitability must be furnished by the contractor to the Engineering Project Manager. These requests for substitution must be submitted to the Construction Bureau in time to permit approval and inspection without delay of the work.

Use of Locally Available Materials
(106.02.1) and (106.02.2) and (106.02.3)

Materials used to construct the structural section immediately below the pavement may be obtained from locally available sources, as follows:

- Sources selected by the contractor.
- Sources indicated by the Department.
- Mandatory sources designated by the Department.

The above sources may include materials for aggregate surfacing, selected surfacing, or borrow materials from pits or rock quarries.

Although the contractor shall bear the complete expense of acquisition, development, production and incorporation of materials into the roadway from all sources, it remains the Engineering Project Manager's responsibility to approve the incorporation of those materials into the roadway. Most mateials are subject to quality assurance specifications. Some informational testing is done as a courtesy to the contractor even though it's not required. When the results of such testing indicate that the materials are not meeting the specification requirements, the Engineering Project Manager should inform the contractor of this and make proper notes in the diary and in the test reports. Occasionally, such improperly produced materials will meet specifications after other screening has occurred, but more often these improperly produced materials will not meet specifications at a later date and, therefore, the proper documentation of directions and information given to the contractor to adjust the methods can be invaluable. The Engineering Project Manager should make written notations describing the deficiencies to the contractor while the materials are being produced.

The Department may indicate two or more sources from which materials of acceptable quality are understood to be available. The right to decide the order of sequence and extent to which each source shall be used remains with the contractor unless the use of the source is mandatory.

Materials Acceptance or Rejection
(106.01.3) and (105.03)

Engineering Project Managers should not assume that previously approved materials will remain acceptable throughout their time in a storage site. Occasionally, various aggregates will break down under prolonged periods of weathering. Metals may rust. Other materials may be contaminated by water or air pollutants. It is therefore good project management to inspect any materials that may be suspected of not being acceptable prior to their use. However, the Engineering Project Manager should avoid any unreasonable practices in retesting materials.

The Engineering Project Manager and inspectors should frequently consult the Montana Materials Manual for the proper test to use in accepting or rejecting materials. The majority of materials tests involve a standardized process accepted throughout the nation by various testing agencies — AASHTO or ASTM. Therefore, the majority of materials tested, accepted, or rejected will have an authorized test report to verify the acceptance or rejection. Occasionally, an obvious flaw or defect may be observed by the inspector and called to the attention of the contractor's representative. The contractor may not see the defect as the inspector does. When such cases exist, the inspector should provide a test to disclose the defect. Then rejection of the material has a valid basis. Where mutual agreement between the inspector and the contractor's representative as to flaws or defects exists, then test records may not be absolutely essential, because the contractor will fully intend to correct those defects pointed out. However, the inspector should make the proper notation in the diary and inform the Engineering Project Manager of the discussion and defects found and corrective action taken.

Legal Relations and Responsibilities
(107)

Laws to be Observed
(107.01)

Apparent violations of federal, state, and local laws should be brought to the attention of the contractor by letter after discussion with the District Construction Engineer.

If there is any provision in the contract that appears to be in conflict with any federal, state, or local law, it shall be brought to the attention of the Construction Bureau, who will refer the question to the Legal Division to be resolved.

Federal Aid
(107.05)

The Engineering Project Manager should accompany any federal official who is on the project for the purpose of inspecting any phase of the work. Any discussions, decisions, or deficiencies found by the official should be listed in the Engineering Project Manager's diary.

The Engineering Project Manager should become familiar with the federal regulations applicable to his project and ensure that they are reasonably conformed to.

Projects administered by the Federal Highway Administration under the "Stewardship Agreement" procedure are not subject to detailed review and approval at the various stages of project development. Under this procedure, the Department assumes many of the previous FHWA inspection and monitoring duties during the construction phase of a project. Advance approval of normal change orders by the Federal Highway Administration is not necessary on "Stewardship Agreement" projects. Change orders involving major changes or changes in design or specifications should be discussed with the FHWA. The FHWA will conduct audits, reviews, and final inspections during the construction phase to insure compliance. Projects with an "F" following their project numbers are under FHWA oversite.

Occupational Safety and Health Act
(107.01)

The Department's policy in regard to OSHA monitoring and violation reporting is as follows:

1. The contractor has direct responsibility for compliance by law and also as a contractual obligation under Section VIII of PR 1273 included in all federal aid contracts.

2. Department of Transportation monitors the contractor's compliance. The basic guide for monitoring is the orange booklet titled "Construction Industry — OSHA Safety and Health Regulation Digest." Department personnel do not have the authority to enforce or direct the contractor to perform specific actions.

3. Procedures for reporting apparent violations are (a) Verbal notification to contractor's field supervisors, (b) Written notification if not corrected within reasonable time, (c) Notification of OSHA if written notice does not produce correction in a reasonable time.

The following procedure is to be followed in cases of apparent violations.

- The contractor's superintendent will be notified verbally.
- Written notice shall follow if no action is taken noting the location, a brief written description of the apparent violation, and a reference to the applicable regulation. The last pages of the orange digest cross reference booklet items to OSHA regulations. Please note that the original is to be given to the contractor's authorized representative on the site with a copy to their main office.
- The Engineering Project Manager will promptly notify the District Construction Engineer if the apparent violation has not been corrected at the end of the time stated in the written notice.
- The District Construction Engineer will notify OSHA of any failure to correct apparent violations within the written notice time period.
- The Engineering Project Manager will note the date corrective action was taken and other pertinent information on the back of the project file copy of the written notice if the apparent violation is corrected within the allotted time period.

The above notification procedure is to be implemented immediately by telephone in cases of failure or refusal to take action to correct an extreme hazard resulting in imminent danger to life.

To avoid Department liability, project personnel are not to direct the specific methods to be used, or offer opinions on the adequacy of methods used.

OSHA monitoring is to be done as a part of regular field inspection duties.

Equal Employment Opportunity, Training, and Minority Business

All federal aid projects have strict rules concerning employment practices of the contractors involved in the work. The provisions concerning equal employment opportunity are made a part of every federal aid contract and are to be followed strictly.

Certain projects have provisions for training of individuals at partial government expense in construction occupations. The Special Provisions governing the training program will be included as part of the contract.

The rules and regulations for employment and training and the responsibilities of Department personnel in monitoring the contractor's activities have been explained fully in a manual published by the Civil Rights Unit of the Department of Transportation titled "Title VI Compliance Program." This manual is your guide to Equal Employment Opportunity and Training programs on all federal aid projects.

Labor Compliance

The Engineering Project Manager has certain responsibilities to ensure that the contractor is complying with federal regulations concerning working hours, conditions, proper payroll records, posting of wage information, and other details. The federal requirements are made part of the contract in "PR-1273 Required Contract Provisions," which are attached to the contract documents. Each Engineering Project Manager should have a current copy of the "Labor Compliance Manual" issued by the Federal Highway Administration through the Human Resource Division of the Department.

Public Convenience and Safety
(107.06)

General

It is the responsibility of the Engineering Project Manager to ensure that the contractor is at all times conducting the work to assure the least possible inconvenience to the traveling public.

To minimize inconvenience, the Engineering Project Manager should contact the property owners adjoining the construction site to discuss how the project will affect them. The contractor should then be made aware of the discussions so that the construction activities can be conducted with the least inconvenience possible.

Contracts in urban areas will often contain a special provision requiring the contractor to conduct a formal public advisory program.

Accident Reporting

Accidents are to be reported as follows:

1. Accidents involving State-owned equipment: Report on Form #141
2. Personal injuries to State employees: Report on Montana Division of Workers' Compensation Form 37 (Employees First Report).
3. Accidents involving other than State-owned equipment or personnel: Report of incident on Department of Administration Form.

This form is to be used for any incident where the State may be liable, is subject to lawsuit, or is otherwise involved. Obvious State involvement occurs when an incident happens in construction zones or maintenance work areas.

Accidents or incidents on State-maintained public roads should also be reported if State liability may be involved.

Examples of incidents or accidents to be reported on this form include but are not limited to:

- Incidents: Alleged damage to vehicle parts, such as windshield, headlights, tires, shocks, muffler, etc.
- Accidents: Injury to other than State employee or non-State vehicle accidents.

If the occurrence happens during working hours, the employee in charge of the construction zone or maintenance area will make out this report.

If the occurrence happens during non-working hours, the Engineering Project Manager or Maintenance Chief will get the necessary information through the proper officials (Highway Patrol or Sheriff's Office, etc.) and complete the report.

The form must be signed by field personnel and the District Engineer/Administrator and sent directly to the Risk Management Unit.

Very often lawsuits develop as a result of accidents and may not come to trial until several years after occurrence of the accident. Therefore, the Engineering Project Manager must make a full report of the facts involved to the Department of Administration. Report facts to include weather conditions, signing on the project, signing leading to the project, posting of restrictive speed limit signs, dates when signing was installed, and the general condition of the traveled way. Any hazards that may be involved and whether these hazards had forewarning should also be documented. Photos should be taken of all signs in place at the time of the accident and other features that may be related to the accident. A copy of the report and an attached drawing indicating the accident site in relationship to traffic control devices or other project features to identify the accident location should be submitted to the District Construction Engineer and to the Construction Bureau.

Protection and Preservation of Property

(107.10)

The contractor is responsible for all damage or injury to property during the prosecution of the construction project. The contractor is to restore at his own expense any public or private property that becomes damaged through acts of omission, neglect, or misconduct of the contractor. The construction contract will not be considered completed until all such damage has been satisfactorily restored. The

Engineering Project Manager should record the dates, times, and descriptions of various events involved where property damage occurs.

Forest Protection
(107.12)

Work performed adjacent to or within the boundaries of a state or national forest must be performed in accordance with the rules of the authority having jurisdiction. The Engineering Project Manager and the contractor's representative should meet with the the individual having charge of the forest and discuss the conduct of the work, schedule of operations, laws to be observed, sanitary provisions, etc., for the contractor's and state forces involved. The contractor is responsible for obtaining the various permits necessary, but the Engineering Project Manager should have in his files copies of the various permits that are necessary. The Engineering Project Manager should record in the diary all discussions dealing with protection of forest property.

Use of Explosives
(107.09)

The Engineering Project Manager should discuss the use of explosives with the contractor to ensure that all permits have been obtained and that suitable warning devices are on hand.

The Engineering Project Manager should also ensure that the signs in advance of the blasting are in place and in good condition at all times.

Water Pollution Laws and Permits
(208 and 107.11)

Following are the different water pollution laws, with an explanation of the permits required, what they cover, where to get them, and who does what about getting them.

Montana Streambed and Streambank Preservation Act

This is a state law that effectively requires Department of Fish, Wildlife and Parks (DFWP) approval of highway plans. This approval is obtained by the Department of Transportation during the preconstruction phase. DFWP approval is often subject to conditions as to how and when the work must be done. These conditions are generally included in the contract as special provisions so the contractors can take them into account when bidding. The Department of Transportation is responsible for enforcing them as part of the contract.

The approval obtained during preconstruction generally applies to the permanent work. The contractor must submit plans for temporary facilities for DFWP approval through the Department of Transportation.

Flood Plain Management Act

This is a federal law that is generally administered by local officials, usually county commissioners. A permit or approval is required for construction within certain areas of designated flood plains. This approval is generally obtained by the Department of Transportation for the permanent work. It is the contractor's responsibility to obtain approval for any temporary work facility such as haul or work bridges.

Montana Pollution Discharge Elimination System

This is a federal law administered by the State Department of Environmental Quality. It applies to what are called point source discharges. To put it simply, a point source is any visible flow that runs into stream, pond, lake, or other body of water. Examples are discharge from a wash plant or from dewatering pumps. A permit, commonly known as a General Discharge Permit, is required for any point source discharge. The time required to obtain these permits can range from 40 days to 180 days.

Montana Water Quality Standards

These are rules set up under state law to establish the minimum standards for water quality in almost every stream in the State. They are administered by the State Department of Environmental Quality. Paragraph 6g of these rules allows a variance from these standards to be issued under certain conditions for short term construction activities. Almost any construction activity that discolors the water the slightest amount is in violation of these standards, and a variance is necessary. Digging riprap keyways, channel changes, and the like, almost always require one. Variances are mainly concerned with installation methods. Acceptable methods can vary from contractor to contractor due to different approaches and equipment. The application period and processing for a variance does not take long. The Department of Transportation does not apply for or obtain variances for these reasons. It is the contractor's responsibility to apply for and comply with the terms of water quality variances. They are obtained through the Water Quality Bureau, Department of Environmental Quality in Helena. The Water Quality Bureau generally works very closely with DFWP on these. Engineering Project Managers are to obtain copies of variances before allowing any work requiring them.

Section 404 of the 1972 Amendments to the Federal Pollution Control Act

This section of the Federal Pollution Law controls dredge and fill operations in United States waters. United States waters include the area within ordinary high water of all streams flowing 5 cfs or more,

adjacent wetlands, and lakes and ponds. Ordinary high water has been described as the line between vegetation that normally grows on land and that normally growing in water. Section 404 is administered by the U.S. Army Corps of Engineers. Streams in the Columbia watershed are under the Seattle District, and those in the Missouri under the Omaha District.

A permit is required under Section 404 for any dredging or fill work. The Department of Transportation has made application during preconstruction for items of permanent work which require it. Typically, these include culverts in flowing streams, fills in water, spur dikes, riprap, and channel changes.

It is the contractor's responsibility to secure 404 permits for temporary facilities such as haul roads, haul and work bridge approach fills, and the like. The permit is not required if the entire width between ordinary high water is bridged and no fill is placed. Enforcement action can include cease and desist orders and fines.

Section 208 of the 1972 Federal Amendments

This section applies to non-point sources of pollution, which generally take in almost all activities outside the stream itself. It requires the best soil erosion and sediment control management practice be applied in any land use activity. Highway construction is considered a land use activity.

This program is set up for local development and administration of regulations following broad federal guidelines. The local soil conservation district is usually designated to administer regulations.

Press releases on the studies almost always mention construction as an offender. Best management practice on our projects requires comprehensive and realistic erosion control plans and timely installation of temporary and permanent erosion control measures. Close attention to these things will counter some of the criticism and hopefully head off more regulations and permits.

Field personnel shall cooperate with enforcement agencies in providing information whenever so requested.

Air Pollution Laws

Contractors are required to obtain air quality permits for crushing plants and hot plants prior to starting operations.

Department of Environmental Quality rules require public notice of the application for a permit. The public notice process can involve considerable time; therefore, the contractor should be encouraged to make application for an air quality permit at the earliest possible date.

A permit is required at each location. Permits acquired at one location may not be transferred to another location. The Engineering Project Manager should request a copy of the permit from the contractor prior to starting operations.

Historic and Archaeological Preservation
(107.22)

Federal and state regulations require the protection and preservation of archaeological resources encountered during the construction of a project.

In the event remains of prehistoric peoples dwelling sites or artifacts of historical or archaeological significance are discovered during excavation operations, immediate action must be taken to preserve the site. This means that the contractor's operations must be stopped so that no damage is made to the site.

As soon as possible after a site is discovered, the Department of Transportation's archaeologist must be notified so arrangements for an inspection can be made.

Maintenance of Irrigation Water
(104.05.6)

The Engineering Project Manager and the contractor should contact the various landowners along the course of construction who use irrigation water. All efforts should be made to arrange the construction activities so that irrigation water may be used when it is needed. Copies of written approval should be secured by the Engineering Project Manager and placed in the files.

Load Restrictions
(107.08)

Concrete Structures, Pavements, or Bases

No loads allowed until expiration of the curing period. Legal loads allowed only after expiration of the curing period except where overloads are allowed by special permit obtained by the contractor from the Department.

Gravel Surfaces, Primed Surfaces

Legal loads are not enforced. The contractor must repair damage occurring from loaded vehicles and should reduce loads if damage is occurring.

Existing Asphalt Surfaces within and Outside Project Limits, Public Roads Used as Contractor Haul Roads, Frontage Roads, Including P.T.W. or Public Roads within Project Limits

Legal loads are required except where overloads are allowed by permit obtained from local or state officials.

The maximum legal load requirements are as follows:

- 20,000 lbs. — single axle
- 34,000 lbs. — tandem axle
- 105,500 lbs. — maximum total gross weight

Note: Axle combinations and loads are subject to bridge formula.

The Construction Bureau should be contacted if further information is needed.

Insurance Requirements
(107.13)

No construction work is to be allowed until the contractor is fully insured, and if the insurance lapses or is canceled, construction activities must be stopped until the insurance is again in effect.

Prosecution and Progress
(108)

Start of Work
(108.02)

The contractor may not begin work before the contract has been awarded.

Preconstruction Conference
(108.03)

A preconstruction conference will be held with the contractor prior to the actual start of construction.

Interested parties are Labor and Equal Employment Opportunity Compliance Bureau (Federal Aid Contracts only), Bridge Bureau, Traffic Design Unit, railroad companies, utility companies, subcontractors, contractors on adjacent or included units of contract work, Federal Highway Administration, and other agencies with similar interests in the intended construction.

Notification to Labor and Equal Employment Opportunity Compliance Bureau, Bridge Bureau, and Traffic Design Unit will be handled by the District Construction Engineer. A letter or telephone call should suffice as notification to other parties interested in attending.

No preconstruction conference should be conducted over the telephone.

Only one group conference should be held for and be attended by the contractors of different units on one project.

Labor and EEO topics need to be discussed at every preconstruction conference. If the contractors involved have attended a preconstruction conference within the last year where labor and EEO were discussed and the contractors have a good record with the Labor and EEO Division, it will not be necessary to discuss in detail the labor compliance and EEO policies.

Topics of importance include:

- the expected starting date of construction;
- the contractor's intentions for subcontracting (what items and to whom); and
- the expected delivery date of major materials, such as pipe, steel, signs, etc., and contractor's expected schedules.

Engineering Project Managers are encouraged to discuss any item that they believe to be important.

A written report of the preconstruction conference must be made immediately upon conclusion of the meeting. The original and one copy shall be submitted to the Construction Bureau no later than two (2) days after the meeting. The Construction Bureau will make distribution to the Federal Highway Administration when warranted. Copies should be made and distributed to the District Construction Engineer, Project Manager, Labor and Equal Employment Opportunity Compliance Division, Materials Bureau, and other sections of the Department when involved. Contractors and subcontractors should also receive a copy of the report. Other interested parties should receive a copy at their request.

Conduct of the Meeting

The following check list may be used as a guide in preparing for and conducting the preconstruction conference:

1. In advance of the meeting, check to see if all interested parties have been invited to the meeting.
    - Contractor
    - Subcontractors
    - Engineering Project Managers
    - Materials Supervisor

- Safety Section
- Federal Highway Administration
- Labor & Equal Employment Opportunity Compliance Division
- District Construction Supervisor
- Representatives of the Utility Companies
- Representatives of Counties or Municipalities
- Representatives of Railroad Companies
- Right-of-Way Section personnel

2. Introduction of those present.

3. Recording of minutes. Assign an individual to act as recording secretary. This individual should take the attendance records, names, company represented, address, and telephone number.

4. A description of the work to be done should be given.

5. Supervisors both for the contractor and the State will be designated.

   - Contractor's Project Manager, Superintendent, or responsible supervisor, whoever has been designated to act as the agent for the contractor.
   - Contractor's designee to be responsible for traffic control operations.

6. Subcontracting and lease rental agreements should discussed.

7. Right-of-Way.

   - Status of unsecured parcels if such exist.
   - Special conditions that may be required under various right-of-way parcels or agreements.
   - Buildings that may have to be removed.,

8. Utilities and Railroads.

   - Schedule for removal and relocation of facilities
   - Designation of temporary crossing
   - Designation of supervisory personnel for the railroad or utility company
   - The contractor should be told to give the railroad company plenty of advance notice before working across or near their tracks.

9. Municipalities or Counties Affected.

   - Their utilities
   - Proper haul routes, weight restrictions, bonds, other various requirements
   - Hauling hours or other construction restrictions due to traffic anti-noise ordinances and air and water pollution requirements

   - Designation of adequate safety measures
   - Approval by Department of Health for construction or relocation of sanitary sewers

10. Materials Control.

    - Intention of the Department to enforce all specifications involving materials
    - Contractor is responsible for untested material.
    - Brief review of special provisions pertaining to or providing particular emphasis on various materials
    - The Materials Supervisor should discuss borrow pits, any selective gradings required, requirement that contractor submit list of proposed source of all materials.

11. Construction Traffic Control.

    - Project Traffic Control plan
    - Control of dust
    - Cooperation with local traffic authorities

12. Contract Special Provisions.

    - Review Special Provisions to ensure everyone's understanding.

13. Construction Safety Program.

    - Discussion by the Safety Section manager or safety coordinators

14. Change Orders, Work Orders, and Similar Recommendations.

    - No work is authorized to proceed until acceptance and approval of change order, work order, or supplemental agreement.
    - Designate authorized representative of prime contractor to sign authorizations for change orders, work orders, supplemental agreements.

15. Labor Compliance (when required).

    - Contractor's payrolls and reports. State's intention of making periodic or frequent spot checks. Posting of minimum wage determinations.
    - Federal Highway Administration regulations, various inspections
    - The quality of pay documentation and payment practices
    - Intention to be fair in all dealings with the contractor, how disputes and controversies are to be handled. Engineering Project Manager to District Construction Engineer to Construction Bureau to Administrator of the Department, then Commission.
    - For a detailed outline of items to be discussed, see the "Labor Compliance Manual" issued by the FHWA.

16. Equal Employment Opportunity

    - Requirements for Federal Aid Projects
    - Reporting procedures

- Responsibilities of EEO Officers, District and Engineering Project Managers
- On the job training when applicable

17. Miscellaneous Discussions.

    - Special agreements
    - DFWP requirements for preservation of trout streams and lakes in recreation areas or similar locations abutting or bordering the highway or bridge construction.
    - Insurance requirements
    - Reclamation requirements
    - Erosion control
    - Air quality permits

Contract Time
(108.07)

General

The Engineering Project Manager has the authority and responsibility for the assessment of contract time. Time charges should be discussed with the contractor's representative on a day to day basis.

The Engineering Project Manager should carefully look over the special provisions, proposal, and other terms of the contract for matters peculiar to that one contract. Clauses other than the usual contract time clause may appear, such as, "no work is to be started until all materials are on the job available for incorporation into the work, or the contractor shall not begin work until a certain date." Such clauses, if not executed properly, will cause much difficulty in assessing liquidated damages or completing a project on time.

The time allowed for completion of the contract is determined by either the working day or the calendar date method.

Working Day Contracts
(108.07.2)

Each and every working day will be judged on its own merits, whether it is or is not assessable.

Time will be assessed if the weather is such that the contractor can proceed on the sequence of operations that would be in progress at the time for a minimum of 60% of the normal daily schedule being worked. The Engineering Project Manager must look at the situation carefully to determine if 60% of the normal daily schedule could be worked. Take into consideration how many hours a day the contractor has been working, how many people are employed on construction activities, and how much equipment has been working. An example of an easy situation is one in which the contractor's entire operation is

shut down by weather after 6 hours. If the contractor had been working 9-hour days normally, one day would be charged since 6 hours is 67% of the normal schedule. If the contractor had been working 12 hours, then the day would not be charged.

Situations where some of the people and equipment are shut down and others can continue to work are more complex and will require careful analysis to decide if the day should be charged or not.

Working days when the contractor is not on the project are to be evaluated the same as any other day. Consider what the contractor would be doing were he present and evaluate accordingly.

Contract time assessment is documented on Form CB 15. To properly document contract time during the life of the contract, the form must first be issued for the week the Notice to Proceed is effective regardless if working days are charged or not.

In the event the contractor files a written protest concerning the time assessed, the Engineering Project Manager is to resolve with the contractor the time charges for the days in question as soon as possible. If the time charges cannot be resolved at the project level, the District Construction Engineer is to resolve the days in question by discussion with the contractor. After resolvement, a revised Form CB 15 should be issued for the week involved.

When the Special Provisions state that time is not to be charged until sufficient material is on hand, it should be noted on Form CB15. In this case, it will not be necessary to issue subsequent CB 15 forms until the material is on hand and contract time charges resume.

The project diaries should reflect an accurate description of project conditions for every day.

Calendar Date Projects
(108.07.1)

On calendar date projects, time is not evaluated on a day-to-day basis and, therefore, there is no need for the report "Assessment of Contract Time." If there is a delay to the completion of the contract beyond the control of the contractor, then a time extension can be considered. Accurate and detailed dairies by project personnel are just as important on a calendar date project as any other.

There are certain projects, such as SMP Stockpiles, where the special provisions will require time to be charged during the winter months. Form CB 15 is then to be issued during this period with a line drawn through the last sentence on the form.

Work Suspension and Resumption
(108.07.3)

General

The Engineering Project Manager will decide when to suspend or resume work on the project. Should a work suspension be necessary for reasons not within the contractor's control, the Project Manager is to verbally inform the contractor and note the reasons for suspending the work on CB 15.

When work is suspended for reasons entirely within the control of the contractor, those working days are charged against the working day allotment. Materials that do not comply with specifications, improper conduct of the contractor's work crew, improper equipment, and failure to perform the work as directed are some of the reasons within the contractor's control that would cause a work suspension. Notification to suspend work in such cases should be by a letter notifying the contractor of the deficiencies requiring a suspension. Time charges during the period when the contractor is suspended from working for reasons within the contractor's control will be evaluated as usual and reported on CB 15. When the reason for the suspension no longer exists, a letter authorizing the contractor to resume work is to be issued.

Should the contractor elect to suspend work without an order by the Engineering Project Manager, contract time will continue as if the contractor were working. The contractor shall be responsible for any damage to the work.

Should it become necessary to suspend work for an indefinite period of time, the contractor is required to protect the construction that has been partially completed or completed by providing adequate drainage for the roadway, opening ditches, making shoulder drains, or undertaking any other precautions the Engineering Project Manager may direct. All materials are to be stored in an acceptable manner so that they will not be a hazard to the traveling public or become damaged or stolen during the period of suspension.

Suspension of Contract Time Charges
(108.07.5)

Care must be exercised in suspending time charges. If time is to be suspended, the CB 15 will show which days are nonchargeable and why. During extended suspensions of time the a note of CB 15 should be made indicating that future reports will not be issued until conditions are suitable for resumption of time charges. If necessary, attach substantiation for the suspension to the report. The following items show ways of handling some of the problems encountered.

1. If time charges are suspended due to late delivery or unavailable materials, the contractor is to provide letters from the supplier substantiating this and produce evidence that reasonable attempts have been made to obtain the items elsewhere.

2. Time charges may be suspended for delays caused by lengthy curing periods, such as those required when sealing road mix, if the delay prevents the contractor from working 60% of the normal schedule at the time. The CB 15 should state the date when the curing period ends and time charges will be resumed. This also includes delays due to after affects of inclement weather.

3. Time charges are not to be suspended when all but minor items of work are complete. Time is to be charged until all work, including cleanup, is complete to the satisfaction of the engineer. Suspend time charges when all work is complete even if the final inspection has not been made. In no case should the delay of a final inspection cause a contractor to incur liquidated damages.

4. Explain clearly the reason for the time charge suspension. Do not use the reason "Inclement Weather" without explaining what made it inclement and how this affected the work. For example, "high winds made it impractical to paint or apply vegetative mulch."

5. During the time period between the "Notice to Proceed" and the contractors actual start of work, time should be assessed in the normal manner. The contractor is to be given the CB 15 showing days assessed and those days nonchargeable for inclement weather occurring during this period the same as if he was actually on the job working. Mail the report to the contractor's record-keeping office if necessary.

6. A contractor may accomplish partial work during a period of authorized time suspension. As long as the weather or the other conditions causing the time suspension prevail, no time will be charged. As soon as conditions improve to allow the normal work sequence to begin, time charges will resume.

Certificate of Completion

(105.15.2)

General

The "Certificate of Completion of Construction Contract" form is designed to include approved time extensions allowed for extra and/or additional work. The CB 15 will show the total of all approved time extensions through the specified date of the respective report, and the Certificate of Completion will show the final total of all approved time extensions.

The time extensions allowed for work performed in accordance with a change order should be part of the agreement. The extra time should be commensurate with the quantity and difficulty of the work, but as a minimum it should be computed by the formula in Article 108.07.3.

When the revised contract time or date as shown on the Certificate of Completion exceeds the number of working days used or extends beyond the work completion date, it will not be necessary to submit a recommendation concerning liquidated damages.

In the section titled "Gross Overrun in Contract Time or Net Time Credit," please strike out the item not applicable when submitting the Certificate of Completion.

The Certificate of Completion should be submitted immediately to serve as notice of actual contract completion. If a delay is necessitated in submitting the Certificate of Completion, the District Office shall notify the Construction Bureau of project completion and reason for delay in submitting the form.

The procedure of showing approved time extensions on the CB 15 and Completion Forms should keep the contractor well informed and keep our own records up-to-date on chargeable contract time. It will also eliminate the need for writing recommendations for waiver of liquidated damages when contract time plus approved time extensions exceed the completion time.

Secondary Road and Bridge Projects.

Agreement of acceptance of Secondary Projects by the County Commissioners is required. After the District Construction Engineer contacts the County Commissioners on an inspection of the project, their signatures on an acceptance report should be obtained. Construction Form No. 1 is to be used to obtain County Commissioners' acceptance.

Evaluating an Overrun of Contract Time
(108.08)

If an overrun of contract time occurs, the following items should be considered when evaluating the situation.

1. Were delays in progress due to reasons within the contractor's control? Was a time extension requested in writing for delays not within the contractor's control?
2. Was the contractor given credit for additional time as shown on change orders, extra work orders, and supplemental agreements? Was the contractor allowed time for additional work not great enough to require change orders?
3. Was the completion date extended an amount equal to the delay of award (applies only to calendar date projects)?
4. Did allowed time extensions on calendar day or date contracts extend time into the November 15 to April 15 period? If so, any time in this period should not be counted as an overrun.

Default and Termination of the Contract
(108.09,.10)

This action will be taken at the Helena Headquarters level. The Engineering Project Manager may be asked to furnish various documents and reports to support this action.

Measurement and Payment
(109)

General

Should a question arise as to measurement or payment of an item, the District Construction Engineer should be contacted for clarification. If it cannot be resolved at the district level, it should be referred to the Construction Bureau.

Measurement of volume by vehicle load is not a desirable method of quantity determination, because it is not possible to obtain a water level capacity load each time. Use of this method is discouraged, and requests for conversion from a weight to volume basis should be made only when: quantities needed are so small it would be economically unfeasible to install a scale; or extenuating circumstances such as a long haul to the scales and/or work being accomplished early in a project and scales have not yet been erected.

Requests for method of measurement change should be initiated by the contractor in writing and preferably handled by change order. A method of measurement change usually results in a cost reduction to the contractor, and a cost reduction in a like amount should be realized by the State.

Pay Quantity Documentation
(109.01)

General

The Engineering Project Manager is responsible for assuring that complete and accurate records are maintained. Erasures are not permitted in field books. If a recording error is made, draw a line through it without destroying its legibility and make the correct entry. Copying of notes should be avoided. If it becomes necessary to copy, the copied part must be so marked and the original submitted as part of the notes. Each day's notes are to be dated and initialed. When adding additional information to previously prepared notes, each new entry shall be dated and initialed. All pay quantity documentation is subject to audit and review and therefore must be complete, accurate, and established in a manner that is clear, concise and easily followed and understood by personnel unfamiliar with the project.

All contract pay items must have written data to support payment. The notes should include all pertinent information as to station, method of measurement (tons, cubic yards, square yards, lump sum, pounds, each, etc.), dates of installation, names of crew or staking party, inspector, recorder, tester, etc.

Adding machine tapes should be used on those items where note preparation or quantity determination is enhanced. They are not required in notes that lend themselves to page totals or accumulated totals.

Each notebook should be indexed to show what items are included and on what page or pages they may be found. A summary at the end of each pay item is not required if the notes lend themselves to accumulative totals and project splits are not involved. If the estimate reflects splits, then a summary should be prepared.

When a standard drawing lists specific quantities for a particular item, the standard drawing quantities can be used in lieu of computations. It is not necessary to redraw and recompute the item in the notes.

Preprinted forms for culvert, signing, gravel, and transit notes, etc., are available. They are to be used on all projects where applicable.

Lump Sum Items

All lump sum items require documentation. Notes for these items should reflect the date the work started, a brief description of equipment and methods used, the date the work was completed, name of the inspector, and amount involved in both percentage and monetary value. If the work was accomplished during several estimate periods and was paid on a progress basis, the notes should reflect the percentages paid and the estimate numbers on which partial payment was made.

Lump sum items may require accomplishment of one or many subitems to achieve a 100% complete contract item.

Extra Items

When an extra item is handled by change order, it should be noted that change order quantities, are estimated quantities and the change order in itself is not sufficient documentation for pay purposes.

Deductions from contractor earnings for claims are recorded on the summary of earnings page or the page that reflects the net amount due the contractor. Place any nonspecification material adjustments or change orders reflecting negative units under predetermined line items on the estimate.

Payment for Excess Material

If the contractor elects to accept the scheduled prices, the Engineering Project Manager will ascertain, by cross section, scale tickets, or other adequate method, the quantity of material purchased by the State. The documentation used should reflect the estimate number on which the material was paid.

Partial Payments

(109.06) and (109.07)

- Payments may be made for portions of completed items such as signing, fencing, guardrail, etc.
- Partial payment for signing can be at the unit bid price for those items that are in place and accepted.
- Partial payment for guardrail or fencing can be based on the linear feet of posts or poles in place and computed at 60% times the linear feet in place times the unit bid price.
- Payment will not be made for nonspecification work. Example: loose posts, poles, etc.
- Form C-8 work sheet can be used to record partial payment items; however, the notes should reflect the station-to-station run to be paid, estimate number on which it was paid, and date of final completion.

Progress Estimate Submittal Periods

Progress estimates are due in the Missoula and Butte District Offices on the first day of each month. Great Falls, Glendive,and Billings Districts estimates are due on the 15th day of each month.

Supplemental estimates can be submitted to correct errors in payment or for refinery produced products. These estimates should also be submitted to coincide with either the first day or the 15th day of the month.

Examples:

- To provide further information, examples of estimate entries have been prepared and can be found at the back of this section. The examples are designed to provide format only and do not encompass entire projects.
- Standard estimate format with project split.
- Transfer of an item from one split another.
- Transfer of an item from one project to another within the same contract.
- Payment for Quality Assurance.
- Concrete class change for structure.
- Concrete class change.
- Aluminum to steel standards.
- Aluminum increment to high-density plywood.
- Work by Agreement.

- Extra Work Order.
- Material taken over from contractor.
- Material taken over by maintenance.
- Payment for concrete pavement with deficient thickness.
- Placement of deductions of claim from payment on estimate.

Semi-Final Estimate

Semi-final estimates are prepared in the same manner as progress estimates.

If there is $500.00 or less between the last progress estimate and the final estimate, a semi-final estimate is not required.

If payment has been made on a semi-final estimate, and during the course of checking there is found to be $500.00 or more due the contractor, a revised semi-final estimate will be submitted.

Semi-final estimates will date from that of the last progress estimate to the completion date.

Final Estimate

General

The contractor may submit a written request for a partial release of retainage whenever a project is substantially complete and only minor items remain to be accomplished. The District Engineer/ Administrator will review project status and recommend an amount that can be released. Project status as mentioned above is as follows: there are no claims or liens filed against the contract; all material samples and tests are accounted for; labor compliance is current, and the contractor has obtained and submitted written consent from his surety.

The Standard Specifications do not prescribe payment of interest on final moneys due the contractor. Payment of interest rates may be forestalled by prompt preparation and submittal of the final estimate. All final estimates are due in the Construction Bureau no later than 90 days after completion of the project.

Preparation

Final estimates are prepared in the same manner as progress estimates. If during the course of checking there is found to be $500.00 or more due the contractor, a revised semi-final will be submitted.

Diaries

- Due to the increase in contractors' claims, litigation, and liquidated damages, the need to maintain a detailed, factual, up-to-date diary cannot be stressed enough.
- Daily entries are required and should contain information relative to date, weather, engineering personnel, contractor's personnel and equipment, other pertinent information such as discussions with the contractor or a landowner, conflicts with the traveling public, condition of detours and construction signing, etc.
- Signatures on every page.
- Complete pages 2 through 5.
- Pages 6 through 9 must contain all items paid on the final to include roadway materials and railroad flagging. These items will be broken out in the same manner as the detail estimate. It is not necessary to list change orders that increase or decrease an original contract item.

Miscellaneous Supporting Data

All material sources, regardless of whether State or contractor optioned, will have a Gravel or Borrow Pit Report. An original with four copies is required for each pit and will contain the following information.

- Ownership
- Laboratory numbers if applicable
- Gravel weight — list all material by type with respective pounds per cubic yard (rodded weight).
- Material removed from pit — list all material by type with respective tons and cubic yards removed. This information will be broken out by roadway split if applicable. This information will be followed by three totals, namely, estimated amount in pit, total amount removed, and total amount remaining. These totals are to be in cubic yards.
- Remarks — a statement concerning general pit condition is necessary. Example: 25% of the pit area was disturbed; the source is exhausted; long, poor haul road; difficult to maintain specification on the 4 mesh/200 mesh, etc.
- Royalty cost should reflect total pit yardage by roadway split, price per cubic yard, and total money.

A mileage comparison (one original and two copies) is to be submitted on all projects involving roadway construction, even though there may be no change in mileage. A report is not required on projects involving just fencing, lighting, signing, seeding, etc.

White Prints (Bridge Projects) or Mylars

The as-built construction prints must agree with construction notes, summary sheets, comparison sheets, and final estimate in respect to quantities, lengths, size, stationing, grade changes, and material changes. All changes to the as-built prints will be in red.

All approaches, inlet ditches, outlet ditches, ditch blocks, culverts, U-turns, etc., if changed, should be lined out and replotted.

Culvert installations are reflected on both the plan and profile. As-Built changes should be shown on the plan portion only and are not required on the profile.

All final monumentation should be plotted on the as-built construction prints.

All guardrail changes, additions, or deletions are to be shown.

On some projects the plans or special provisions will provide for alternate or substitute items or material. The white prints should designate what was actually used. Example: high density plywood used in lieu of aluminum increment; steel standards used in lieu of aluminum standards; one brand of paint used in lieu of another, etc.

Mylar Summary Sheets

Mylar Summary sheets submitted with the final are filed in Helena as a permanent record and must be prepared in a neat, legible fashion. Neat, freehand lettering is acceptable.

All items appearing on the final estimate must be on the summary sheets.

Lump sum items will be shown with a brief description of work accomplished and the total monetary amount.

Extra Work Orders will be listed by work order number, a brief description of work accomplished, and total monetary amount.

Work by agreement items will be placed in or below the appropriate summary frame. Only those work by agreement items unrelated to contract items will be placed in a work by agreement frame.

Corrected quantities must be shown below all typical sections except those that reflect a similar width and depth, such as curve and tangent and transitions thereto. These quantities can be lumped together for the encompassing stations.

Incorporated into the typical section portion will be a summary denoted General Typical Section Notes containing information relative to gravel weight, oil weights, application rates, compacted weight of plant mix bituminous surfacing and/or base and any other information as appearing on the original plans.

Any typical section design change will be shown.

Linens will not be incorporated and/or stapled to the corrected white prints. It is suggested they be rolled separately, and the corrected white prints be rolled around them.

Computer Aided Design and Drafting (CADD)

When possible, use a CADD machine to prepare and revise any as-built plans. Follow the current policies on the revision of CADD-prepared plans. These are available from the District Engineering Services Supervisor.

Acceptance and Final Payment
(109.08)

Submittal of the Certificate of Completion of Construction Contract form to the Construction Bureau will be sufficient notice of actual project completion. In the event this form cannot be submitted immediately following the actual project completion, the District Construction Engineer will notify the Construction Bureau of the actual completion date and reason for delay in submittal of the form.

The district office through prechecking and the Engineering Project Manager through pursuance of quantity computation, notebook preparation, and checking of various items should provide a short time period between issuance of the Certificate of Completion and submittal of the final estimate and supporting data.

Retention of Records

The requirements for record retention are set forth in Federal-Aid Highway Program Manual, Volume 1, Chapter 6, Section 2, and Appendix A.

Periods of retention vary according to record type and relation to the project. Project-oriented records (project file generally) may be destroyed after three years with FHWA permission.

Financial and accounting records are to be retained for four years before destroying. Again FHWA permission is required before the record can be destroyed.

State of Montana
Department of Transportation
Highways Division
CHANGE ORDER

Change Order No.: 1

Project No.: IR 90-9(75)549

Designation: Wyoming Line - North

To: Jones Construction Company

Date: 5/20/90

You are hereby directed to perform the following work, constituting changes in the approved contract. The Highways Division will not be liable for any work not provided for in the contract and performed prior to the approval thereof.

Work Description

Excelsior AMXCO HI-Velocity Curlex blankets will be used in lieu of fiber glass roving that is required by special provision 14 for erosion control in the median from Station 1042+86 thru Station 1122+06.

Discussed with: Roy R. Smith, Jr., P.E., District Engineer, 5/5/90
Myron L. Rose, P.E., Dist. Const. Engineer, 4/28/90
Mark Painter, Const. Bureau, 5/4/90
Jeff Holmes, Environmentalist, 5/5/90
Larry Oleson, P.E.,FHWA Area Engineer, 5/10/90

The payment shall be in full compensation for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work.

Estimate and Cost

Note: The quantities shown are not guaranteed. Payment will be based on actual quantities.

County: Big Horn
Type Code: I000
4 Lane - Rural

Item No.	Split	Quantity	Unit	Unit Description	Unit Price	Amount
208010121	01	3,520.00000	LB	Fiber Glass Roving	$2.24000	$7,884.80-
208010122	01	2,464.00000	GAL	Bit Mat'l SS-1 Roving	$2.24000	$5,519.36-
CO 01-01	01	6,705.00000	SQ YD	Excelsior Blanket	$1.55000	$10,392.75

Time extension 0 days

Total Cost Decrease $(3,011.41)

I hereby understand and agree to the terms and conditions set forth in this instrument.

Prepared by _____ 10/17/90
Field Project Manager

Recommended by _____ 10/17/90
District Construction Engineer Date

By _____
Contractor or Firm Date

Approved by _____ 10/17/90
District Engineer Date

Title _____

Approved by _____
Construction Bureau Date

Transmitted to FHWA - Date:

Approved by FHWA - Date:

Form CO-13 (5/91-JH)

State of Montana
Department of Transportation
Highways Division
CHANGE ORDER

Change Order No.: 1

Project No.: F 1-3(18)256

Designation: Cut Bank - East

To: Jones Construction Company

Date: 4/17/91

You are hereby directed to perform the following work, constituting changes in the approved contract. The Highways Division will not be liable for any work not provided for in the contract and performed prior to the approval thereof.

Work Description

As per Standard Specifications for Road and Bridge Construction, Article 109.07 and Memorandum dated March 14, 1991 by the Construction Engineer; Materials in Storage Payment for Haul on Bituminous Mixtures will be based on actual 6.5 miles. The mileage falls into the range of 5-10 miles which will be paid at 45%.

This was discussed with Roger Owens, P.E., DCE and Howe Adams, P.E., FHWA.

The payment shall be in full compensation for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work.

Estimate and Cost

Note: The quantities shown are not guaranteed. Payment will be based on actual quantities.

County: Glacier & Toole
Type Code:

Item No.	Split	Quantity	Unit	Unit Description	Unit Price	Amount

Time extension 0 days

Total Cost Increase $ 0.00

I hereby understand and agree to the terms and conditions set forth in this instrument.

Prepared by _____ 4/12/91
Field Project Manager

Recommended by _____ 4/12/91
District Construction Engineer Date

By _____
Contractor or Firm Date

Approved by _____ 4/12/91
District Engineer Date

Title _____

Approved by _____
Construction Bureau Date

Transmitted to FHWA - Date:

Approved by FHWA - Date:

Form CO-13 (5/91-JH)

State of Montana
Department of Transportation
Highways Division
CHANGE ORDER

Change Order No.: 1

Project No.: F 5-4(7)160

Designation: Dickey Lake - North & South

To: Jones Construction Company

Date: 11/20/90

You are hereby directed to perform the following work, constituting changes in the approved contract. The Highways Division will not be liable for any work not provided for in the contract and performed prior to the approval thereof.

Work Description

Wet areas encountered building the subgrade will be subexcavated and backfilled with 3" select surfacing. It is anticipated an additional 9,238 cu. yds. of this material will be required for the digouts.
The contractor will be paid an additional $1.17/cu. yd. to place this material because of the small quantities, equipment and personnel required.
This change order supersedes changer order no. 4.

Discussed with: Bob Oleson, 7/29/90

The payment shall be in full compensation for furnishing all labor, tools, equipment, materials and incidentals necessary to complete the work.

Estimate and Cost

Note: The quantities shown are not guaranteed. Payment will be based on actual quantities.

County: Lincoln
Type Code: I000
2 Lane - Rural

Item No.	Split	Quantity	Unit	Unit Description	Unit Price	Amount
301020161	01	9,238.00000	CU YD	Selected Surf 3" GR 2	$ 8.00000	$73,904.00
CO 01-01	01	9,238.00000	CU YD	Place 3" Select Bkfill	$ 1.17000	$10,808.46

Time extension 3 days

Total Cost Increase $ 84,712.46

I hereby understand and agree to the terms and conditions set forth in this instrument.

Prepared by _____ 11/7/90
Field Project Manager

Recommended by _____ 11/16/90
District Construction Engineer Date

By _____
Contractor or Firm Date

Approved by _____ 11/16/90
District Engineer Date

Title _____

Approved by _____
Construction Bureau Date

Transmitted to FHWA - Date:

Approved by FHWA - Date:

Form CO-13 (5/91-JH)

FORM CS-12

STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXTRA WORK ORDER

(FORCE ACCOUNT BASIS)

Extra Work Order No. 1
Project No. FF 7-2(3)69
Designation Victor - Florence

TO Jones Construction Company
CONTRACTOR

In accordance with the provisions of the Standard Specifications, amendments and Special Provisions governing your contract, you are hereby authorized to perform extra work as outlined below.

The amount to become due the contractor will be determined by the Engineer as provided by the Standard Specifications. The Department of Highways will not be liable for the payment for any extra work performed or materials furnished prior to the approval of this order.

DESCRIPTION OF WORK AND SPECIFIC INSTRUCTIONS TO CONTRACTOR

Install 315 Ln. Ft. of 6" Steel Casing at Station 100+50, as directed by the Engineer.

This work will be performed by Borrow Construction Company, an approved Subcontractor.

Discussed with H.S. Adams, Construction Bureau 12/12/90

The Costs shown below are estimates only. Payment will based on force account records for actual work performed.			AMOUNT
Total Material	$1,298.34	Plus 15 %	$1,493 09
Total Direct Labor	$685.62	Plus 80 %*	$1,234 12
Total Equipment			$652 48
Administrative Expence Allowance (Sub-contractor Work)			$186 36
		Premium on Bond 1%	$36 02
Time Extension 1 Days		Total Estimated Cost	$3,602 07

I hereby understand and agree to the terms and conditions set forth in this instrument.

Jones Construction Company
Contractor or Firm

By 12/08/90
Date

Title

Prepared by
Field Project Manager

Recommended By
District Const. Supr. Date

Approved By
District Engr. Date

Approved By
Const. Bureau Date

Revised 5-14-91

*See Article 109.04(B)(1)

Transmitted to FHWA
Approved by FHWA

Project Number FF 7-2(3)69
E.W.O. Number 1

Statement of Daily Force Account Work

Page No. 1
Date July 7, 1990

Description of Work Installation of 6 inch Steel Casing at Station 100+50.00

Labor

Name		Classification	Hours	Rate	Extended amount
Frank T. Johnson	3-94	Loader Opr.	4	$13.21	$52.84
Percy E. Thomas	3-66	Welder Opr.	2	$13.31	$26.62
Stanley W. Wilson	1-35	Labor-Pipelayer	8	$10.60	$84.80
John E. Murphy	1-35	Labor-Pipelayer	8	$10.60	$84.80
Ralph B. Hinkle		Foreman	2	$14.50	$29.00
NOTE: CSN 12 Forms used as examples in the Construction Manual are typewritten for clarity only.					

Wage rates verified against: Subcontractor Payroll

Payroll number 10 Dated 7/3/90 thru 7/9/90	Total payroll	$278.06
Contractor: Sub X Prime	Labor surcharge @ %	
	Others Travel Pay for Operator, Welder & Foreman-8 hrs. @ $1.375	$11.00
	Laborer-16 hrs. @ $1.375	$22.00
	Subtotal	$311.06
Verified by:	+ 80 % on labor costs	$248.85
	Page total cost of labor	(A) $559.91
	Total labor cost brought forward	-------
	Total to date cost of labor	(A) $559.91

CSN 12
csc

Materials	Unit	Quantity	Unit Price	Amount
6 Inch Black Steel Pipe	Ln. Ft.	126	$4.10	$516.60
Selding Rod	Lb.	12	$0.36	$4.32

Rental rates obtained from: Dataquest Rental Rate Blue Book - Volume 1	Subtotal	$520.92
	+ 15 % on material costs	$78.14
	Page total cost of material	(B) $599.06
	Total material brought forward	-------
	Total to date for material	(B) $599.06

Equipment	Hours	Rate	Extended amount
Pickup 3/4 Ton (4x2 Conventional)	2	$10.02	$20.04
Loader 3 Cu. Yd. Rubber (Diesel)	4	$60.68	$242.72
Welder - Portable 300 AMP (Gas)	2	$8.02	$16.04
Air Compressor - 175 CFM (Gas)	4	$10.53	$42.12
Tamper - Air	4	$1.33	$5.32

Approved hours

Contractor's Representative Title

State Representative Title

Approved rates and extensions

Contractor's Representative Title

State Representative Title

Page total cost of equipment	(C) $326.24
Equipment cost brought forward	-------
Total to date for equipment	(C) $326.24
Administrative expense to be applied to final cost of (A) plus (B)	
Total to date (A) (B) (C)	$1,485.21
+ premium on bond	
Total force account to date	

CSN 12

Project Number FF 7-2(3)69
E.W.O. Number 1

Statement of Daily Force Account Work

Page No. 2
Date July 8, 1990

Description of Work Installation of 6 inch Steel Casing at Station 100+50.00

Labor

Name		Classification	Hours	Rate	Extended amount
Frank T. Johnson	3-94	Loader Opr.	4	$13.21	$52.84
Percy E. Thomas	3-66	Welder Opr.	2	$13.31	$26.62
Stanley W. Wilson	1-35	Labor-Pipelayer	8	$10.60	$84.80
John E. Murphy	1-35	Labor-Pipelayer	8	$10.60	$84.80
Ralph B. Hinkle		Foreman	6	$14.50	$87.00

Wage rates verified against: Subcontractor Payroll

Payroll number 10 Dated 7/3/90 thru 7/9/90	Total payroll	$336.06
Contractor: Sub X Prime	Labor surcharge @ %	
	Others Travel Pay for Operator, Welder & Foreman-12 hrs. @ $1.375	$16.50
	Laborer-16 hrs. @ $1.375	$22.00
	Subtotal	$374.56
Verified by:	+ 80 % on labor costs	$299.65
	Page total cost of labor	(A) $674.21
	Total labor cost brought forward	$559.91
	Total to date cost of labor	(A) $1,234.12

CSN 12
csc

Materials	Unit	Quantity	Unit Price	Amount
6 Inch Black Steel Pipe	Ln. Ft.	189	$4.10	$774.90
Welding Rod	Lb.	7	$0.36	$2.52

Rental rates obtained from: Dataquest Rental Rate Blue Book - Volume 1	Subtotal	$777.42
	+ 15 % on material costs	$116.61
	Page total cost of material	(B) $894.03
	Total material brought forward	$599.06
	Total to date for material	(B) $1,493.09

Equipment	Hours	Rate	Extended amount
Pickup 3/4 Ton (4x2 Conventional)	2	$10.02	$20.04
Loader 3 Cu. Yd. Rubber (Diesel)	4	$60.68	$242.72
Welder - Portable 300 AMP (Gas)	2	$8.02	$16.04
Air Compressor - 175 CFM (Gas)	4	$10.53	$42.12
Tamper - Air	4	$1.33	$5.32

Approved hours

Contractor's Representative Title

State Representative Title

Approved rates and extensions

Contractor's Representative Title

State Representative Title

Page total cost of equipment		(C) $326.24
Equipment cost brought forward		$326.24
Total to date for equipment		(C) $652.48
Administrative expense	to be applied to final cost of (A) plus (B)	$186.36
Total to date (A) (B) (C)		$3,566.05
+ 1%	premium on bond	$36.02
Total force account to date		$3,602.07

CSN 12

Form CB 12A

STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXTRA WORK ORDER

(FORCE ACCOUNT BASIS)

Extra Work Order No. 1 Page No. 1 of 2

Project No. FF 7-2(3)69

Designation Victor - Florence

LABOR COST ESTIMATE

BARE LABOR COST

Classification	Hours	Rate	Amount
Foreman	8	$14.50	$116 00
End Loader Operator	8	$13.21	$105 68
Welder (Operator)	4	$13.31	$53 24
Laborer	32	$10.60	$339 20
Bare Labor — Page Total			$614 12
Bare Labor — Accum. Total			$614 12

TRAVEL PAY

Classification	Hours	Rate	Amount
Foreman @ $11.00 per day	8	$1.375	$11 00
Operators @ $11.00 per day	12	$1.375	$16 50
Labors @ $11.00 per day	32	$1.375	$44 00
Travel Pay — Page Total			$71 50
Travel Pay — Accum. Total			$71 50

Accumulated Total - Direct Labor Cost	$685 62

Revised 5-14-91

Form CB 12B

STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

EXTRA WORK ORDER

(FORCE ACCOUNT BASIS)

Extra Work Order No. 1 Page No. 2 of 2

Project No. FF 7-2(3)69

Designation Victor - Florence

MATERIALS AND EQUIPMENT COST ESTIMATE

MATERIALS

Item	Unit	Quantity	Unit Price	Amount	
6" Black Steel Pipe	Ln. Ft.	315	$4.10	$1,291	50
Welding Rod	Lb.	19	$0.36	$6	84
Materials			Page Total	$1,298	34
			Accum. Total	$1,298	34

EQUIPMENT

Description	Blue Book Sect.-Page	Blue Book Date	Hours	Rate	Amount	
Pickup-3/4 Ton(4x2 Conventional)	20-40	11/90	4	$10.02	$40	08
Tamper-Air	3-46	11/90	8	$1.33	$10	64
Air Compressor-Gas 175 CFM	3-7	11/90	8	$10.53	$84	24
End Loader-Wheel-3 Cu. Yd.(Diesel)	9-47	11/90	8	$60.68	$485	44
Welder-Portable El. 300 Amp.(Gas)	18-36	11/90	4	$8.02	$32	08
Equipment				Page Total	$652	48
				Accum. Total	$652	48

Revised 5-14-91

Chapter Three

Earthwork

General

The Department has developed a handbook titled "Grading Operations." All personnel assigned to earthwork projects are encouraged to use this handbook as needed.

Clearance of Right-of-Way

Protection and Preservation of Property

The Engineering Project Manager is to locate and mark all property to be protected or preserved within the right-of-way. Although the methods and equipment used to protect property are left to the contractor, the Engineering Project Manager should review the work in progress to ensure that property is adequately protected, and when damaged, is properly restored.

Clearing and Grubbing
(201)

Clearing
(201.01), (201.03), (201.01.1) and (201.03.2)

Dead, dying, or otherwise unstable trees, which are within the right-of-way limits, and could fall onto the completed roadway should be removed. Large trees at the top of cut slopes should also be removed if they are likely to pose any danger.

Clearing from right-of-way line to right-of-way line may be necessary in some cases to allow sufficient width for roadway construction. However, this type of clearing is less aesthetic, more costly, and allows for more erosion, so care should be taken to clear only as much as is necessary.

Because clearing operations in particularly dense or tall timber areas can be extremely dangerous, the contractor's clearing equipment should be protected by canopies. All inspectors should be made aware of the inherent dangers, and all State employees are required to wear hard hats when working in the vicinity of such operations.

The contractor is to be directed to use appropriate construction signing, flaggers, and pilot cars whenever there is any danger posed to the traveling public.

Grubbing
(201.01.2) and (201.03.3)

The Engineering Project Manager is to ensure that no questionable material is mixed with embankment soil. Areas of heavy timber, closely spaced small trees and undergrowth may require root raking. No stump should remain if there is any question that it could eventually be detrimental to the roadway.

Disposal
(201.01.4) and (201.03.5)

The contractor may dispose of cleared and grubbed material by burning or burying.

When the contractor elects to dispose of the material by burying, the Engineering Project Manager is to ensure that:

- a copy of the landowner's written permit is placed in the project files,
- each layer of buried material is covered with two feet of sufficiently compacted soil, and
- the area used for burying is topsoiled and seeded.

When the contract elects to dispose of the material by burning, the Engineering Project Manager is to ensure that:

- the contractor follows the conditions and methods stipulated in the burning permits, (it is the contractor's responsibility of obtain permits)
- adequate provisions are made to protect surrounding vegetation and property,
- burning pits have been approved,
- all applicable local, State, and federal agencies have been contacted, and
- the contractor observes all necessary clean-up procedures.

Daily entries in the project diary should include: number of contractor employees working, equipment used, location that clearing began, number of acres cleared or the production rate, and the times burning began and ceased. Any uncontrolled fire should be documented to include the times the fire began and when it was brought under control, the probable cause, the fire control methods used, and a description of the damage done.

A notebook record is to be kept on an area basis, percentage of lump sum, or station to station quantities of right-of-way cleared. When a contract item has been set up to pay for right-of-way clearance, the notebook should show sketches and dimensions where applicable and reflect the quantity of work done each day or time period. When right-of-way clearance is to be absorbed in other contract items, no pay record is needed, but a reasonable record should be kept of the contractor's time expended in clearing operations. If right-of-way clearance has been set up on an individual unit basis, the individual trees (units) are to be measured in place and proper notations made in the notebook to reflect the exact quantities cleared.

A sample page of clearing and grubbing notes when contracted on an acre basis can be found at the end of this section. The staking party information need only be shown on the first page of a days run. The perimeter of the various areas to be cleared or grubbed is generally outlined by trees or brush. Stakes should be set at convenient locations to outline this perimeter. After staking is completed, the various areas should be computed and their quantities checked against the planned quantities, and any discrepancies resolved.

Removal of Buildings, Structures, and Obstructions

(202)

Structures and obstructions designated for removal are to be marked to clearly define what is to be removed and what is to remain. All designated salvage material is to be removed without damage. Steel structures that are to be removed and are required to be salvaged should have the matching component clearly marked prior to disassembly so that reassembly will be correct. A list of the salvageable material, its location and condition, is to be made for the project files and submitted to the District Construction Engineer.

All wells encountered in the route of the proposed roadway are to be abandoned in accordance with the State laws and administrative rules of Montana.

Excavation and Embankment
(203)

Preparation of the Roadway Foundation

Removing Topsoil
(203.03.6)

All objectionable vegetation is to be removed from the natural ground before stripping topsoil.

The Engineering Project Manager should assist the contractor in selecting a suitable site for stockpiling topsoil. Areas that will minimize haul and not interfere with other construction operations are most desirable. In no case should the stockpile be located where drainage will be impeded.

A sufficient supply of topsoil is to be stockpiled before beginning excavation or embankment construction. The Engineering Project Manager should review the sites where topsoil is to be excavated to ensure that random stripping will be avoided.

Cut to Fill Transitions

Transition sections should be undercut and recompacted as necessary to provide a firm keyed foundation. The removed material, if satisfactory, may be recompacted along with the embankment material.

Continuous benching may be performed in the cut to fill transition area to prevent slip planes from forming.

Embankment Foundation
(203.03.2)

The Engineering Project Manager should direct the contractor to compact soils outside the width of the subgrade if there is any question as to the stability of the foundation. This compaction should be measured and recorded for payment.

Areas beneath the proposed embankment containing muck or compressible material should be excavated to solid earth when the depth to a solid foundation is not excessive and when excavation is more economical than other corrective measures. If potholes are wet after removing the unstable material, this excavated area should be backfilled with granular material. Areas under the proposed embankment containing a series of sharp knobs and depressions should have the knobs leveled and the adjacent holes filled before resuming embankment construction. Roads and trails made for the

contractor's convenience that underlie the proposed embankment should be properly compacted. If not, the portions underlying the proposed embankment should be reworked and recompacted before embankment operations proceed over these roads or trails.

Every hillside in or adjacent to the right-of-way should be thoroughly inspected for any sign of landslides. Typical indicators include rolling terrain in an otherwise smooth landscape, hummocked grass on normally smooth hillsides, trees or brush leaning downhill, or twisted trees, poles or fence lines. Protective or corrective measures have to be made before excavation begins, but only after consultation with the Geotechnical Section and the Construction Bureau.

Subgrade in Cut Sections

The subgrade in finished cut sections must be uniform. This applies to both materials and compaction. All hard and soft spots have to be removed, backfilled, and compacted. Subgrades composed of different, but acceptable material should be scarified, blended and compacted.

Excavation

Unsuitable Materials
(203.03.2)

Many soils such as peat, mulch, some silts, and some highly expansive clay are unsuitable because they are unstable. Normally, these soils are wasted, or used to flatten slopes. However, the detrimental effects of some of the less suitable soils may be minimized by placing these soils near the bottom or lower center of embankments.

Sometimes it is necessary to use silts and expansive clay soils when they are the only types available in the area. Silts may cause heaving when freeze-thaw cycles occur, so they should be placed below the frost line. Expansive clay soils should be placed at a moisture content slightly above optimum, where possible, and protected from any future change in moisture content by membranes or inslope protection when economically feasible. Soils that are borderline may be mixed with better soils to increase their stability.

Clay shale and shale materials are unsuitable as a subgrade because of low shear strength and high swell potential. In cut sections, the swell problem is much greater because of the high undisturbed density. Corrective procedures may include subexcavation and replacement with non-swelling material, or placement of an asphalt membrane or geotextile (preferred) over the subgrade.

When these types of soils are encountered below the subgrade in cut sections, and the plans do not call for sub-excavating, the Geotechnical Section and the Construction Bureau should be consulted to determine the depth of sub-excavation and the type of backfill to use.

Excess Materials
(203.03.2)(G)

The terrain and suitability of locally available materials may require that a project be planned for borrowing and wasting of material rather than balancing the cut with the fill material. In such cases, disposal areas and borrow sites will have been previously established. However, when no provision for disposal of excess material has been provided for in the contract, the Engineering Project Manager is to notify the District Construction Engineer. It may be necessary to contact the right-of-way section to obtain the use of a disposal area. Disposal areas should be selected so that drainage will not be impeded and so the appearance of the facility is improved. The Engineering Project Manager should notify the District Construction Engineer as soon as the need is known.

When the Engineering Project Manager discovers that an excess of material will occur or is occurring, grades may be changed and alignment adjusted to accommodate the excess material providing that adequate sight distance, drainage, and proper safety features are maintained. Excess material may also be placed along the side of an embankment to widen fills, to construct turnouts, scenic viewpoints, or similar facilities. Surplus materials may also be placed between the embankment and right-of-way line or in loops and gores of interchanges.

Care must be taken to minimize embankment erosion when excess material is used to widen the embankment slopes. Widening is to be made along with the original embankment so that proper compaction is obtained. Loose material should not be dumped on slopes of high embankments.

Slopes
(203.03.4)

Every cut slope should be inspected for visible signs of distress as excavation progresses. When slope instability is anticipated, the Engineering Project Manager should discuss the situation with the District Construction Engineer and FHWA officials, if appropriate. Every effort should be made to take corrective action as soon as possible.

Serrated slopes may be specified for large cuts consisting of soft rocks. Serrated slopes consist of horizontal steps constructed into the slopes during excavation. The steps may vary from 2 to 4 feet vertically, with the horizontal dimension being a function of the staked slope ratio. The approximate midpoint of the horizontal tread of the step should be constructed on the staked slope line with the top step beginning just below the soft rock line. The steps should be constructed approximately horizontal rather than parallel to the centerline grade. Excavation of each step should be in the opposite direction from the preceding one to minimize buildup of loose material at the ends of the steps. Loose material which collects at the ends of steps should be removed and the ends blended into the natural ground. Where rock is too hard to rip, the steps should be blended into the rock.

Blasting of Rock Cuts
(203.03.1)(B)

General

Normal operations employ a track mounted unit to drill the production blast holes. Spacing of the drill holes into a regular pattern that will give optimum breaking with a minimum powder charge to the rock with no damage to the planned cutslope is the objective of the primary blast. Commonly used terms in blasting include:

Burden — The shortest distance from a free face to the first primary hole or holes. Burden distance should be about 2/3 the spacing distance.

Hole Spacing — The distance between holes measured perpendicular to the burden.

Powder Ratio — The total powder explosives used divided by the total cubic yards of rock in a given blast. This ratio normally runs 0.5 to 0.75 lbs/cubic yard.

Refer to any standard blasting handbook for any term you are unfamiliar with.

Presplitting
(203.03.1)(B)(4)

Where it is desirable to produce a smooth cut face with a minimum of blast damage, presplitting is usually specified. This type of blasting is most commonly employed in the harder rocks such as granite, basalts, and layered rock-hard shales, sandstones, limestones, and argillites.

Presplitting of rock cuts consists primarily of drilling a series of closely spaced parallel holes (usually 30 inches apart or less) that will reasonably conform to the designed cut lines and grade. Presplitting operations are performed prior to the primary blast to break into and permit escape of blast hole gases and energy. Controlling the loading of these holes, the firing sequence, and hole spacing, a smooth plane should be produced form one hole to another along the presplit fracture plane without damage to the backslope outside the excavated limits.

After the first presplit blast, the condition of the rock face should be checked. Modifications or adjustments can then be made to control poor presplitting results. Excessive rock fracturing, as evidenced by fracturing outside the neat line, may necessitate one or all of the following:

- Reducing the powder charge
- Changing the hole spacing

- Decreasing the powder charge spacing
- Redistributing the charge in the hole

Blasting Record (Form CSN55)
(203.03.1)(B)2

Lift Number — Place number of presplit lift starting with No. 1 at natural ground level.

Hole Attitude — Show degrees from vertical that holes are drilled. Examples: 14 degrees corresponds with a 1/4 to 1 slope. 26 1/2 degrees corresponds to a 1/2 to 1 slope.

To the right of the space for hole attitude, circle one or two directions that show the direction the hole slants.

How Loaded — Show the distribution of the powder charge within the hole and if the charge is in every hole. Example: Every other hole loaded with 1/4 pound of 40% extra strength dynamite per linear foot.

Sketch of Primary and Presplit Ignition Sequence — Show and number the sequence of the primary blast. Sketch the free face, stationing, centerline of road, and location of presplit holes.

The Engineering Project Manager is to submit Form CSN55 to the Geology Section of the Materials Bureau in Helena.

Embankments
(203.03.2)

General

Embankment construction normally begins with filling the low areas first and then bringing up the first lift. The first lift may be slightly dished, but the contractor should work toward making each successive lift approximately parallel to the finished grade. Frequent checks should be made to see that the work conforms to the proper cross section, that large roots and other organic materials are being removed and properly disposed of, that drainage facilities are open, and that the embankment site is in the best condition possible to provide maximum run-off from storms. All temporary and permanent erosion control features should be installed wherever they are needed to protect newly constructed slopes.

Hauling equipment should be routed in different paths. This procedure is particularly necessary when hauling over expansive clay to avoid ruts and over compaction.

To assist in uniformity and compaction, several light, lift applications are more desirable than one heavy application. The water truck should work from one side of the fill to the other to avoid wet or dry streaks in the center or edges of the embankment.

Rock Embankment
(203.03.2)(E)

Hauling vehicles should place rocks adjacent or near to the final position. Other equipment should then move the pile of rock to its proper position at the correct lift height in the embankment. The coarse and fine materials can usually be distributed so that voids will be filled with small stones and earth to make the embankment as dense and compact as possible. Vibratory grid rollers are very effective in reducing the size of rocks, especially, shot rock, and for re-orientation of rock and stone particles to maximum density of the lift. As a rule, rocks should not be dumped over the edge of completed work. However, when end dumping is the only practical work method, the rock should be dumped on top of the layer being built and then moved ahead on as flat a slope as possible, maintaining a lift no thicker than required to support the equipment.

Earth Embankment
(203.03.2)(D)

Density and moisture must be correct and uniform. Excessively deep layer placement has to be avoided. Continual visual inspection is to be made of compaction and embankment construction methods and equipment.

Embankment over Swampy Areas
(203.03.2)(F)

Methods of traversing swampy areas generally consist of totally excavating the undesirable material and properly disposing of it, or providing a sufficient weight of embankment (surcharge) that will displace the swampy material when the depth of the swamp is too great to excavate. The soft ground may be bridged with an embankment composed of a wide bottom and very flat side slopes.

The use of geotextile reinforcing over a natural surface with fill placed over the top for the roadway produces a layer which keeps the aggregates from mixing with the underlying soil. Such mixing has to be avoided because it can cause instability in the subgrade.

Swampy areas or soft areas are normally shown on the plans with the specific method of construction outlined in the special provisions. However, all low, poorly drained or swampy areas that do not show

on the plans are to be checked for their ability to support the planned embankment. Consult the District Materials Supervisor and Materials Bureau—Geotechnical Section—to determine if questionable areas will have the strength to support the embankment.

Embankment at Structures
(203.03.2)(B)

Piers, bents, and culvert structures have been pushed out of line or subjected to undue stresses because of improper backfilling practices. Backfill is to be compacted uniformly in layers brought up equally on all sides of the structure to reduce pressure. All unsuitable material should be removed and replaced. In order to ensure that the structure will not be damaged, it is advisable to use hand operated tampers adjacent to the structure.

Compaction, Moisture, and Density
(203.03.3)

Frequent check tests will ensure that each soil type characteristic is represented by a MT-218 density test. As an aid in identifying the various soil types, samples can be placed in jars and labeled.

When meaningful test results cannot be obtained, explanations as to why the tests could not be made are to be entered on the compaction test report form along with an explanation of how acceptance is being made.

Because silty soils are quite sensitive to small changes in moisture content, the correct moisture content should be determined by adding water in small increments and processing thoroughly.

When expansive shales are encountered, the Geotechnical Section should be consulted for assistance and testing if necessary.

Soils with expansive characteristics occur frequently, especially in areas where the Bearpaw or Niobrara shales occur. Expansive soils that have been placed and compacted in a dry state will absorb considerable moisture during a wet season, and if highly compacted, these soils will swell considerably. Expansive soils must be treated or protected so that moisture content and density (after compaction) will not change significantly throughout the lifts. The use of a construction disk is invaluable for uniform mixing of water into fine grain soils.

The following method may be used as a quick way to determine the approximate moisture content. However, it is never to be used in place of the standard method of determining optimum moisture.

Roll a soil sample tightly into a ball about the size of a golf ball, and then squeeze it. If the ball breaks into several fragments of uniform size, the soil is at or very near optimum moisture. If the ball flattens without breaking, there is too much moisture. If the soil cannot be rolled into a ball, or if it is difficult to roll into a ball, there is not enough moisture.

The air-voids method (MT 229) may also be used as a test for density.

Upper Two Feet of Subgrade

The material in the upper two feet of the subgrade largely determines the pavement section thickness. The pavement may fail much sooner than expected if there is a substantial difference between what is placed and what was used for design.

The design surfacing report shows the type of subgrade material that was used in designing the pavement section. This is to be made available to, or acquired by the Engineering Project Manager before construction begins.

In some cases, a particular soil class or better will be specified for the upper two feet of the subgrade. In other cases, the specifications will call for the material to have a particular Resistance (R) Value. In still other cases, neither is specified because the design is based on the material that is available.

In all cases however, it is necessary to ensure that the actual subgrade is reasonably consistent with the design. This can be done by comparing the class of material used to that used in design. Samples are to be taken in accordance with the frequency required by the policy on grading jobs for "R" value testing.

Records and Documentation

The grading inspector is required to keep a daily diary in addition to the project diary and should include:

- Date, weather, and soil conditions
- The number of hours worked each day, and equipment used

Note: The above information should be a more detailed explanation than that included in the project diary.

- Type of work performed (channels, rough or finish grading, etc.)
- Any condition that delays the prosecution of the work
- Amount of work performed

Grading Inspector's Check List

- Each lift is placed at the proper thickness for the type of material used
- Water is uniformly mixed
- Moisture content is at optimum or near optimum
- Compacted density is within tolerance
- Unsuitable material from excavation is disposed of properly
- Excavated materials used in embankment are inspected for suitability
- Provisions for adequate drainage have been made
- Engineering Project Manager kept informed daily

Haul: Balance Points

(206)

The simplest form of planned movement of material consists of summing excavation and embankment quantities until points are reached where excavation quantities equal embankment quantities, adjusted to shrinkage or swell. These points, called balance points, include all materials and requirements in addition to the actual roadway earth work. Balance points establish the limits between which no borrow or waste should be necessary.

Mass Diagram

The direct distribution of excavated material and the quantity of waste or borrow may be determined in advance by the use of a mass diagram. When the haul is long, it is frequently cheaper to obtain fill material from borrow pits rather than from roadway cut sections. When borrow material is obtained, the material from cut section is wasted rather than transporting it to distant fills. The economics of whether to balance a project or use a waste and borrow procedure are complex and are best solved by the use of a mass diagram. The mass diagram is a line set up on a rectangular coordinate system that indicates the relative quantities of cut and fill throughout the project. For the purposes of constructing or reviewing a mass diagram, the cut lines are recorded as plus and fill as minus with the balance line as a reference. Cut and fill volumes placed on the mass diagram have been adjusted for swell or shrink and will form a continuous line crossing and recrossing the balance line from the start to the finish of a project.

Measurement and Payment

(206.04.1)

Haul computations are made from the approximate center of volume of the excavation area to the approximate center of volume of the embankment area, along centerline or a line parallel to the main roadway under construction.

The distance materials are moved from borrow sites to the highway right of way will be measured along the shortest practical route from the approximate center volume of the pit to the point of entrance onto the project. From the point of entrance onto the project, the distance will be measured along centerline to the embankment site or disposal area. The haul distance will be the distance from the center of volume of the borrow pit to the center of volume of the embankment or disposal site.

Payment for haul can be made on excavated material or aggregates when so provided for in the individual contract, but may also occur as the result of extra work deemed necessary to satisfactorily complete the highway.

Payment for haul will be made on the basis of the most economical route as indicated on the final mass diagram analysis even though the contractor does not follow the original mass diagram. The inspector must check the excavation and embankment quantities as the work proceeds to be sure that the planned shrinkage or swell factors used are matching the actual construction quantities. A substantial change in the shrinkage or swell factors indicates that a change in planned grade, ditch, or side slopes may be necessary to avoid large overruns or underruns in the final pay quantities.

Earth work quantities taken from channel changes, inlet and outlet ditches, trenches, stripped areas, or materials used for approaches, ditch blocks, dikes and similar features must be included in the final calculation of haul quantities.

Records

The quantity and type of records necessary to document payment for haul are necessarily included in cross sectional measurements and the subsequent volume computations made by other project personnel. It is important that the inspector, through daily diary entries, keep a reasonably accurate account of material moved within balance points or material disposed of or taken from a borrow area. Good records of the haul operations should include the direction of haul, the approximate quantity of material moved each day, any changes ordered by the Engineering Project Manager, and any undirected cross haul maneuvers performed by the contractor. The grading inspector's records should also include the amount of material hauled past the original balance points. Unless balance points are determined from field observation and the quantity of material moved past these balance points accurately determined, no accurate calculation of swell or shrinkage of the actual quantities can be determined.

Chapter 4

Culverts and Minor Drainage Structures

The Department has developed two excellent references: "Culvert Inspector's Handbook — General," and "Culvert Inspection Manual."

These references cover everything from staking to documentation, and include a number of excellent drawings and examples of calculations. Personnel assigned to drainage projects are encouraged to use these references as needed.

This chapter will be reserved for additional information and direction as the need arises.

Chapter Five

Aggregate Surfacing

General

The Department has developed a handbook titled "Aggregate Surfacing — Inspection Manual." All personnel assigned to aggregate surfacing projects are encouraged to use this handbook as needed.

Sampling, Testing, and Acceptance (301.03.1 and 105.03.2)

The contractor is responsible for controlling the quality of all material produced. The Department will determine acceptability based on the specifications identified above.

Construction

(301.03.5)

Surface Inspection

(301.03.5)(A)

Before the aggregate is placed, the surface should:

- Have the proper grade and cross-section,
- Be smooth and compacted to the proper density, and
- Be free of bumps, depressions, and soft areas.

Sometimes problems in the surface, such as pumping, do not appear until loaded trucks pass over the surface. When pumping is discovered, its cause should be found. In some cases, the problem can be corrected relatively quickly. In other cases, a drainage adjustment may have to be made. Problems such as this should be well documented, along with instructions given to the contractor, and the actions taken.

Placement

(301.03.5)(B)

All project personnel should be aware of the legal load limits and ensure that they are enforced.

Although controlling the quantity of material placed is important, it is equally important to ensure that the material is placed at the proper thickness. Yield checks and depth checks should be made frequently.

Segregation

One of the most important aspects of inspecting placement is to ensure that the material is evenly graded over the entire surface. Segregation is indicated by concentrations of fine or coarse aggregate.

Contamination

Any foreign material will adversely affect the quality of the aggregate surface. The contractor should be informed whenever foreign material is observed and subsequently correct the cause of the problem.

Compaction and Construction Methods

(301.03.5)(D)

Target density, as well as construction methods (layer thickness, placing, compacting, and rolling) will be determined for aggregate surfacing based on MT-230. Because subsequent densities taken on other lifts will be compared to the test lift, project personnel should ensure that all methods used in construction remain unchanged.

Chapter Six

Bituminous Pavements

Surface Preparation
(204)

Aggregate Surfaces
(204.03.2)

Soft or segregated areas of the surface on which the pavement is to be placed must be corrected or replaced. These areas, as well as the entire surface, must be examined to ensure proper compaction. Insufficient compaction will cause depressions in the finished pavement.

An optional prime coat of light bituminous material may be placed on the upper surface of the aggregate to protect the base from destructive action of traffic, minimize moisture penetration into the base material, and to provide a firm surface upon which to place the hot asphalt mix. The liquid asphalt used for prime coat must be applied in the correct quantities. Too heavy an application is not only wasteful but may cause slippage, instability, or bleeding in the finished pavement.

Necessary adjustments must be made in the surface or base section before paving operations begin. A night inspection with the low-angle light from headlights may reveal irregularities in surface smoothness normally unseen in daylight.

Existing Roadway Surfaces
(204.03.3)

Particular attention must be given to the condition of the existing roadway when overlay pavements are to be placed. The causes of deficiencies must be determined from surface and base conditions, and then proper corrective action taken.

In street sections, catch basins, manholes, or other similar facilities may need to be adjusted to the proper elevation. In some instances the adjacent pavement curb or curb and gutter may have to be adjusted. In other instances, the old surface material may be removed from street intersections and adjacent areas to provide the proper grade, crown, and drainage for the finished pavement. The paving operation will proceed more uniformly when the surface upon which the plant mix is to be placed has been properly finished to the correct elevation.

Tack coats are usually required between lifts of plant mix surfacing. Application should be from 0.02 to 0.05 gal/sq. yd. and very rarely above .05 gal/sq. yd. SS-1 for tack is an emulsified asphalt that is approximately 30% water and 70% asphalt which is mixed with about 50% additional water on the project before application to the roadway. The net amount of asphalt placed on the roadway is 35% asphalt and 65% water for most applications of SS-1 or SS-2 emulsions.

Mix Design and Job Mix Formula

(401.03.1)

The mix design establishes the correct gradation, asphalt content, stability, voids percentage, and flow value. Mix designs help achieve a long service life by correctly proportioning and controlling the mix constituents.

For quality assurance projects, the contractor is required to submit Form CB-30QA prior to submitting samples for mix design. The mix design will not be done until the form is approved.

Marshall Method

(401.03.1)

Mix design methods utilize the Marshall Method for determining the range in which stability, flow, and voids should fall. Stability values may range from 500, when using rounded aggregates found in the eastern part of Montana, to over 3000 when using the heavily fractured aggregates in western Montana. Values of flow range from a low of near 8 to high of around 16, with values near 12 desirable. The percentage of air voids will generally range from about 3 to approximately 7, with values near 3.0-3.25 desirable. Mineral filler may be added to promote durability and improve asphalt film thickness.

There are certain instances in which projects have been designed with a purposely high asphalt content in order to minimize the effects of absorption or deterioration over a period of time by adding what would appear to be an excessive amount of asphalt.

In some instances, the mix design submitted from Helena can be adjusted to provide for appropriate workability and minimize flushing of asphalt to the surface. Generally speaking, asphalt

pavement surfaces tend to become more slippery with increased usage, and if a bituminous mixture is placed that contains too much asphalt, it flushes to the surface and early rutting usually follows. The Helena mix design approaches values for voids, stability, and density through the use of a small sample, but the overall product must be controlled in the field by the Engineering Project Manager through reliance on Field Marshall Tests and criteria set out in the Materials Manual for this test, visual inspection, knowledge of the quantities of aggregate and asphalt, and how these should combine to make the most acceptable construction product.

Changes to Mix Design

The Engineering Project Manager has the authority to make changes and should not hesitate to reduce excessive asphalt contents or increase low asphalt contents in the field in order to achieve the best product for the State.

Changes in design and job target asphalt content should be made only to optimize mix properties as determined by field Marshall test results. District Materials and Helena Materials must be advised of and concur with significant changes.

The requirement for advising District and Helena Materials of changes is primarily for the purpose of getting a second opinion from people familiar with mix design and materials aspects when a significant change is planned. This should be done by telephone when time is critical. This is not intended to apply to every adjustment made during start-up, but should be done when a target value is finally established.

In order to minimize confusion when dealing with a purposely high asphalt content, the mix design report will state that asphalt contents are expected to be high and relate why. If the Engineering Project Manager has any question about the reasons for a change in asphalt content, the question should be referred to the Materials Bureau in Helena for clarification. In such cases the Materials Bureau and the Construction Bureau personnel will be in close communication to give appropriate direction to the field.

The allowable tolerances established by the job mix variations are the controlling specifications for aggregate gradation and should be shown as such on the daily plant report and on the field summary charts.

Crushed Aggregate Stockpiles

(401.03.1)

Samples of the various aggregate sizes, including blending sand if required, are to be submitted to the Materials Laboratory for testing and design of the asphalt concrete mixture. The actual

percentage quantity of each of the stockpiles to be used by the contractor for the production of the plant mix bituminous material must be furnished to the Materials Bureau to design the job mix formula.

Quality Assurance

(401.03.1)(C)

The quality assurance specification is used for most plant mix bituminous surfacing projects. Under this specification, acceptance will be determined by averaging test results for small portions of the work defined as lots. Depending on the quality of the work, the contractor may receive a price increase, a price decrease, or the amount bid for each lot. The specifications identify the sizes of the lots and the number of tests to be taken in each lot.

The contractor will not have the option of accepting a price reduction in lieu of producing specification material. Continued production of non-specification material will not be permitted. Material which is obviously defective may be isolated and rejected without regard to sampling sequence or location within a lot.

Sampling and Testing Procedures

(401.03.3)

Samples must be selected by random methods in accordance with MT-416. Normally, the lot size will be 3,000 tons and five samples will be selected and tested — one sample for each 600 tons. The first step of the procedure is to determine the sampling location by picking five consecutive numbers from the table in MT-416. For example:

1. .222
2. .980
3. .508
4. .271
5. .634

Each of these is multiplied by 600, giving:

1. .222 x 600 = 133
2. .980 x 600 = 588
3. .508 x 600 = 305
4. .271 x 600 = 163
5. .634 x 600 = 380

The samples should be taken as the following tons are produced:

1. 0 + 133 = 133
2. 600 + 588 = 1188
3. 1200 + 305 = 1505
4. 1800 + 163 = 1963
5. 2400 + 380 = 2780

The selection process must be done for each lot, before it is produced. The contractor should not be informed ahead of time of the selection.

Proper testing is essential and procedures in the Materials Manual must be followed. If this is not done, the results will be open to challenge. Challenges may be expected when substantial price reductions are involved.

A lot will be evaluated for acceptance when all test results are available. A single failing test does not necessarily mean a problem since several results are averaged for acceptance. It would be advisable to inform the plant foreman of out-of-tolerance test results as they become available, but no action should be required or directed.

A copy of the evaluation form will be given to the contractor as soon as possible after it is completed, checked and reviewed by the Engineering Project Manager. All price reductions will be totaled and entered on the estimates as a deduction. This will eliminate the need for change orders.

Plant and Inspection

(401.03.2)

General

It is essential that the inspector thoroughly examine plant equipment and become familiar with different plant features. The mechanical condition of the equipment is to be inspected for safety and proper function. Mixing and production operations should not be started until all mechanical deficiencies and unsafe conditions have been corrected.

The field laboratory should be located where all plant operations are in full view, but out of line of the prevailing winds. The Engineering Project Manager should be sure that all laboratory personnel have copies of the job mix formula, standard specifications, special provisions, and a sufficient supply of the various forms to record all test results, materials received, and mixtures produced. A laboratory should be equipped with the proper testing equipment, power supply, water, and fuel for the stoves and ovens.

Cold Feed
(401.03.2)(A)(12)

The cold aggregate feed is one of the most critical control points in the production of asphalt mixes. While many of the problems such as temperature, moisture, segregation, and bin imbalance are detected in the dryer, on plant screens or bins, or in the pugmill, the causes frequently can be traced back to the cold feed.

Mechanical Feeders
(401.03.2)(A)(3)

Mechanical feeders function from stockpiles or from bins holding the crushed aggregate and are set at a production rate that provides a uniform flow of cold aggregates into the drum. Additional mechanical feeders are necessary when blending sand or more than one stockpile is used. Each mechanical feeder must have feed adjustments that can be secured in any position.

The condition of material introduced into the storage bin and the feeder adjustments should be checked by the inspector frequently. Excessive or numerous adjustments are not desirable and should be discouraged because the change in the rate of feeding different aggregates will affect drum operations and uniformity of the mix.

The specifications allow the contractor the option to use the cold feed control system permitting hot mix plant operation without plant screens with the exception of the scalping screen. But permission to continue under this option may be rescinded upon failure to maintain production within the gradation limits.

Dryer
(401.03.2)(B)(1)

Cold aggregates taken from the stockpile move over conveyor belts into a drum where the aggregates are heated to the required temperatures and excess moisture is removed. Drums are composed of a revolving cylinder usually from 3' to 10' in diameter and from 20' to 40' long, with a gas, coal, or oil-fired burner (see 401.03.2(A)(13) for restrictions). An exhaust system powered by a fan is part of the dust collecting apparatus but its primary function is providing a draft for the dryer. Aggregates enter the dryer and are lifted by flights inside the dryer and then dropped in a veil through the burner flame and hot gases. Drying time is controlled by the slope of the cylinder, its speed of rotation, length, diameter, and the number of flights or channels.

The specifications and mix design establish a temperature range for mixing. The minimum temperature is considered the lowest value for quality paving and the maximum temperature is

specified to prevent overheating. Within this specified temperature range lies an optimum mix temperature that may vary depending upon the source of the asphalt, the type of work being done, weather conditions, air and roadbed surface temperatures, and other factors.

Several adjustments can be made in the dryer to obtain more effective drying of the aggregates. Essentially the time element is the major factor in proper drying of the aggregate. Absorptive or excessively wet aggregates require a longer time than nonabsorptive or dry aggregates. If the aggregate is not being properly dried, the time required for its passage through the drum may be adjusted by lowering the slope of the drum or reducing the speed of rotation to slow the passage of aggregate through the dryer. Remember, the Engineering Project Manager may make suggestions to the contractor for plant adjustment but should not tell the contractor how to run the operation.

The moisture content of the aggregate in the cold feed will tend to become high immediately after a rain, early in the morning, and in the spring or fall when the weather is apt to be cool and damp. Take precautions to ensure that the aggregates are being dried correctly. In most instances drying can be improved by decreasing plant production; however, this is not always the only correction necessary.

Some indications of improper drying or improper operation of the dryer can be easily noticed. For instance, an oil-fired dryer may emit black smoke from the exhaust stack. This is an indication of incomplete combustion or burner oil leaving free oil on the aggregate. An oily residue will make it difficult or impossible to obtain the correct asphalt film thickness. An insufficient draft through the dryer may result in frequent puffs of flame at the combustion end of the dryer or an intermittent rush and subsidence of flame through the dryer. A correctly set draft, balanced with the right volume of fuel and air, will usually eliminate these problems.

A fairly uniform temperature range must be maintained and is essential for high quality work. A pyrometer (temperature measuring device) is used to indicate or record aggregate temperatures in the dryer. The business end of the pyrometer is a thermocouple, which senses aggregate heat at the discharge end of the dryer and must be checked for accuracy and sensitivity. Heavy armor placed around the thermocouple inside the dryer will retard the sensitivity and is usually an unnecessary protective device. The pyrometer can be checked by placing the thermocouple and a thermometer in a pail of hot sand or hot water and comparing the temperature readings. If the pyrometer fails to work or function properly, the contractor should be required to provide a substitute until the instrument is repaired. Inspectors should never attempt to repair or adjust pyrometers or other contractors' equipment.

Dust Collector

(401.03.2)(A)(7)

To prevent air pollution, the Department of Environmental Quality (DEQ) requires an exhaust dust collector. While it is the contractor's responsibility to obtain needed air quality permits, the Engineering Project Manager should be sure the permits have been obtained.

The exhaust fan in the dust collector system moves air through the dryer into the dust collector and out the exhaust stack. Heavy dust particles in the draft air fall into the dust collecting system as the lighter particles are driven out of the stack.

The dust collector then serves two purposes; one is to provide adequate draft through the dryer and the other to collect and remove dust.

Screening Unit (Batch Plants)

(401.03.2)(B)(2)

As the heated aggregates leave the dryer they are transported by a bucket elevator into a screening unit where they are separated into the required size and deposited in separate hot bins. Oversize material falling onto the screen deck is kept from entering the hot bins by a scalping screen. Holes in screens may let the wrong size or oversize rocks fall into fine aggregate bins. If oversize rocks appear in samples or in the mix, suspect holes or other troubles and require repairs.

Screening efficiency is affected by:

- The shape, slope, and size of screen opening and the direction that slotted screens are placed.
- Foreign matter in the aggregates.
- The percentage of fractured aggregates and the shape of the aggregate particles.
- The rotational speed and vibration applied to the screens.
- The condition of the screens regarding wear, holes, or plugging.

The screening unit should be cleaned frequently, and a daily check made for loose, torn, defective, or otherwise impaired screens.

Hot Aggregate Bins and Gate (Batch Plants)
(401.03.2)(A)(4)

Each plant is to be equipped with bins designed to hold the hot aggregate that has been processed and screened into the various sizes required by specifications.

The partitions separating one bin from another are to be tight, free of holes, and high enough to prevent aggregate from one bin flowing into an adjacent bin. The level of material in each bin is controlled by an overflow pipe that will discharge any excess aggregate from that bin.

Fine dust can build up in the corners of bins and then discharge in a quantity large enough to adversely affect the asphalt mixture. The build-up of fine dust in the corners of bins can be reduced by welding fillet plates in the corners. The bottom of each bin is fitted with a discharge gate that may be operated manually or automatically. The gate closure should be positive to ensure that leakage of material into the weigh hopper will not occur. Aggregate samples are obtained from gates or windows in the sides of the bins or by diverting the flow of the aggregates from the bins into the sample containers.

Scales (Batch Plant)
(401.03.2)(A)(9)

Aggregate from the batch plant hot bins fall directly from the bins into a weigh hopper in which batch weights are determined. A weighing mechanism suspends the weigh hopper and is equipped with a springless dial scale on which the weight of the aggregate from each bin can be marked. Markings should be cumulative, and the last mark made to read the total quantity of aggregate in the batch. Once the sequence of weighing material from the bins has been set, it must be strictly observed for each successive batch in order for the material being weighed at that time to be the same as the previous batches.

The scales must be certified by an independent scale inspection angency.

The Engineering Project Manager should personally watch the marking and setting of scale weights, after the batch weights from each bin have been decided upon, to be sure the correct weight is actually being "pulled" at the proper time. Daily checks should then be made to be sure the setting remains in the proper place and that the batch weight procedure is correct. An incorrect scale setting can cause the entire batch to be out of specifications. The sequence of weighing from each bin must be strictly observed and all scale settings correct to help prevent specification violations.

In some batch plants the scales are automatically operated and are electronically connected with the batching equipment so that the scale weights are automatically verified when the correct proportions of material have been weighed.

Inaccurate asphalt content can become one of the primary causes for failures in asphalt pavements. In many cases the cause of failure can be traced through inaccurate asphalt scales. Asphalt scales must be checked daily to ensure that they zero properly, that levers and knife edges move freely, and that drag, friction, or binding is eliminated on the lever system. Asphalt or dust can build up on the knife edges in the lever system, or corrosion can dull the knife edges causing scale malfunction. Each scale should be equipped with a quick adjustment to zero to compensate for accumulations of dust or asphalt.

Asphalt Storage Tanks

(401.03.2)(A)(2)

Asphalt storage tanks provide separate storage for different asphalt materials and are equipped with heating coils so that no flame will contact the tanks. Separate storage tanks must be provided when different grades of asphalt material are being used or are intended to be used on the project. Storage tanks should be emptied and inspected before the initial asphalt is introduced into them; especially when a different grade of asphalt is to be used, because some asphalts may be incompatible when blended.

Asphalt storage tanks are to have a positive means of measuring the quantity contained. Quantities may be measured by gauge, calibrated rod, or float. It is suggested that the tank be calibrated so that quantities can be determined from theoretical batch weights or mix proportions and the scale weights. One method for calibrating the storage tanks is to use a tanker equipped to transfer the asphalt through a positive displacement action asphalt pump and meter. Calibrations should be made at 100-gallon intervals. The inspector should be sure the supply line is below the surface of the asphalt to prevent excess splashing, which may cause false readings or markings. The tank must be set as level as possible.

A change in the source of supply of the asphalt should not be permitted unless serious difficulties are encountered. Similarly, if a change in the grade of asphalt appears desirable, all of the circumstances and details leading to the change should be placed in writing and approval gained before the asphalt grade will be changed. Consult the Construction Bureau in the event that the asphalt source or grade is to be changed, because a redesign of the mix may be necessary before further production is approved.

Pugmill Mixer (Batch Plants)

(401.03.2)(B)(4)

After the hot aggregates leave the storage bins and are correctly proportioned, they are introduced into the pugmill for mixing with the asphalt. The main part of the pugmill mixer consists of paddle tips, paddle shanks, spray bar, liners, shafts, discharge gate, and heated jacket. Material is dumped

into the center of the pugmill mixer where special paddle tip arrangements produce center mixing or a figure eight mixing pattern.

Efficient mixing of the aggregates with the asphalt cement is dependent on many factors such as the shape of the paddle tips, speed of the mixing shafts, length of mixing time, temperature of the materials, quantity of material in the mixer, and the clearance between paddle tips and the liner plates. The clearance should be about one-half the dimension of the largest size aggregate. Paddle tips and liner plates are subjected to continuous wearing action, which, in time, can produce an excessive clearance. When excessive clearance does exist, the materials will be improperly mixed and the paddle tips or liner plates or both are to be replaced.

The pugmill mixer on batch plants is to be equipped with an automatic timing device, which automatically limits the dry mixing or wet mixing periods to the minimum time required by specifications. A time lock device is required by the specifications for the purpose of assuring minimum mixing time. The time lock device will lock the weigh box gate after material is discharged into the mixer and keep it locked until the mixer gate closes when the cycle is completed. The inspector should check the timing occasionally to ensure that no changes have been made..

Dry mixing time is the interval of time between the closing of the weigh box and the start of the discharge of the asphalt. Wet mix time begins when the asphalt is first spread on the aggregate and ends when the mixture completes its discharge from the mixing unit. Mixing time is not to be less than 25 seconds. The asphalt and aggregate mixture is to be homogenous, with all of the asphalt and particles uniformly coated with the correct quantity of asphalt.

The weight of any batch is not to exceed the rated capacity of the mixer as shown on the mixer name plate.

Scales

(401.03.2)(A)(9)(10)

In fully automatic plants equipped with batch counters, batch weights are permitted as a method of measurement in lieu of platform scales. Using this method of weighing, the plant inspector will record the batch counter reading when production is started each day and at the end of each shift.

The plant inspector must issue duplicate punch cards for each truck that is hauling plant mix. The punch cards should be given to each truck driver with the first load to be delivered to the road inspector, who will punch both cards, retain one for the project records, and give the other card to the truck driver.

The use of batch scales for batch plants and hopper scales mounted under the silo for dryer drum plants may be used at the contractor's option. The Engineering Project Manager should require

random loads to be checked on an approved platform scale to ensure the correct weights are being obtained from the batch or hopper scale system.

Each truck must haul the same number of batches on each load. The number of batches shown on the batch counter at the plant must be checked with the batches that are recorded as being delivered on the road. The number of batches that are shown for the shift on the batch counter must be recorded in the daily plant mix notes for documentation.

The plant inspector should check the batches that are loaded on the trucks. It is also suggested that the plant inspector and the road inspector check the plant batch count with the road count two or three times during the day.

When other scale systems are not provided or are not satisfactory, the contractor is to furnish platform scales that have been sealed by the appropriate scale inspection agency. This must be done at each scale location. Frequent checks should be made during the course of production to ensure that the scales are continuing to provide accurate weights. The contractor must have on hand ten 50-pound certified weights for testing the platform scale.

Mix Proportioning

(401.03.1)

The Materials Bureau develops the mix design based on test results and the information furnished regarding the stockpiled aggregates. The contractor picks the job mix target values from within the specification limits for the appropriate materials being produced. It may be necessary to make adjustments in the field in order to meet approved job mix targets.

Aggregate Proportioning for Batch Plants

(401.03.2)(A)(12)

Batch size and batch weight proportions should be discussed with the contractor. Batch plant ratings are usually stated on a plate attached to the side of the pugmill or plant, which indicates the size of the batch that can be properly mixed. Primarily, the size of the batch is consistent with the established hourly plant production rate. After the size of the batch has been determined, the hot bins should be completely emptied, the screening unit checked, and the cold feeders, dryer, and screening plant operated at the full operating rate. During this operation interval, the units should be carefully inspected. Representative samples should be taken from each bin, and a sieve analysis performed as an aid in proportioning. The following is an example of how to determine the proportions of aggregate, mineral filler, and asphalt cement content for a particular batch.

The information provided will show the total weight of the batch and the percentage of asphalt cement and additives. For example:

Batch Weight	4,000 lbs.
Asphalt Cement	6% of the aggregate weight
Mineral Filler	1.5% of the aggregate weight

To find the aggregate weight, divide 4,000 lbs. by 107.5 percent: 3721 lbs. of aggregate

Knowing the weight of the aggregate, simple multiplication will identify the weights of the asphalt cement and mineral filler:

Aggregate Weight	3,721 lbs.	
Asphalt Cement	223 lbs.	(3,721 x .06)
Mineral Filler	56 lbs.	(3,721 x .015)
Batch Weight	4,000 lbs.	

A trial run should be made to determine the sizes going into each bin and the proportions to draw from each bin after general plant operation is deemed satisfactory. The combined aggregate gradation obtained by computing the various aggregate materials in individual bins, mineral filler and the percentages as outlined above, should check the gradation established by job mix formula within the allowable tolerance. If the combined aggregate gradation does not check within the allowable tolerances, it will be necessary to repeat the trial run and weighing procedure or to compute revised proportions based on the gradation of the materials in each bin. Failure to be able to check the combined gradation might indicate that materials in the cold feed were outside gradation as used in computing the job mix formula or that they were improperly fed. Also, the cold feed calibration may not be reliable.

Plant Inspector's Check List

Material Handling and Storage

- Material in stockpiles is free from segregation.
- Materials in separate stockpiles does not intermingle.
- Stockpiled material is within the specification limits.
- Mineral filler is dry.
- Mineral filler feeder provides uniform introduction of the mineral filler.

Dryer and Dust Collector

- Dryer and dust collector are in proper working order and comply with specifications.

- Pyrometer or heat indicating device is checked for accuracy to ensure that the aggregates are being dried at the correct temperature.
- Dust collector checked for its ability to waste or uniformly feed a desired amount of collected fines back into the aggregate flow (batch and continuous flow plants).

Hot Screens and Hot Bins

- Screening capacity is large enough to handle the maximum feed from the dryer and be in excess of the full capacity of the mixing unit.
- Hot bin partitions are sturdy and free from holes. The hot bins overflows are working properly.
- Platforms for sampling, sampling devices, and general access for sampling are safe, accessible, and adequate.

Batch Plant

- Batch scales comply with specifications regarding capacity and sensitivity.
- Mixer parts are in good condition and proper adjustment and provide correct mixing within the time limit specified.
- Correct batch size is mixed and mixing performed within the correct temperature range.

Sampling and Testing for Quality Assurance

- Adequate number of samples are taken on a random basis.
- Tests are performed according to the Montana Test Methods.
- Test results are available as soon as possible.
- Contractor is made aware of test results.
- Daily plant mix form is kept up to date and plant mix gradation acceptance evaluation for quality assurance is completed.
- Daily diary entries are made of the plant operation.

Safety

- No open fires are allowed around asphalt or fuel oil storage tanks.
- Pulleys, belts, sprockets, and other drive mechanisms are covered and protected.

- Oil jackets on asphalt distributor lines checked for leaks.
- "Panic Button" or switch that will stop all operations is provided in the event of an emergency, workmen know the location of the switch, and the switch is easily accessible.

Dryer Drum Mixing Plant

(401.03.2)(D)

Simply stated, dryer drum mixing is a process in which hot asphalt mixtures are produced in a plant without hot aggregate screens, hot bins, and pugmill mixer. The basic plant consists of a cold feed control system, a rotating drum dryer with modified flights, an asphalt proportioning and dispensing system, and a surge bin.

Because the drum mixing plant does not have a gradation screening unit, it is necessary to proportion the aggregate prior to its entry into the mixing drum. For a uniform output from the drum mixing plant, input must be accurately measured. The importance of feeding the exact quantities of each size aggregate to the dryer at the correct rate of flow cannot be overemphasized. The cold bin feeder gates must be accurately calibrated, set, and secured.

A key component of the aggregate and asphalt blending system is the weigh bridge, which continually weighs the aggregate passing over the belt and indicates the flow over the scale at any given instant. One of the conveyor idlers is mounted on the pivoted scale carriage and is designated the weigh idler. As material passes over this idler, the weight is translated into the visually displayed tons per hour reading at the control console. This ensure that the required proportions of aggregate and asphalt are maintained.

In the drum mixer, aggregate is fed into the burner end so aggregate and hot gases move through the drum in the same direction. This allows the hottest gases and flame to exist at the charging end of the drum mixer. The asphalt is protected from the harmful effects of oxidation and direct contact with the burner flame by thermal shields and/or a continuous veil of aggregate dropping from the flights in the dryer.

The asphalt metering and delivery system is interlocked with the aggregate system to ensure the precise asphalt content is achieved and maintained in the mix. Tonnage rate of aggregate going into the drum mixer, as measured by the weigh bridge, is regarded as the base figure of the total mass of both aggregate and moisture. Weight of the moisture, therefore, must be subtracted to arrive at a true aggregate rate reading. Actual moisture content is determined by periodic moisture extraction tests.

While the drum mix process features a continuous flow of material, inside the drum mixer certain events occur in phases within fairly well delineated zones of activity. One of the principle differences between the batching method of mix and drum mixing is the manner in which coating of the aggregate is accomplished.

Phase I

The aggregate has entered the drum mixer. In the early heating phase, surface and free moisture begin to leave the aggregate as the temperature rises.

Phase II

Most of the heat rise occurs in this phase as aggregate temperatures reach approximately 170° to 180°. The majority of the moisture is driven off in this phase, and the rate of increase in mix temperature levels off.

Phase III

As mix temperature reaches between 180° and 200°, asphalt is introduced to the mixture. Moisture driven off now causes the asphalt to foam. This foaming action causes the surface area of the asphalt to be greatly enlarged, thus entrapping dust as well as larger particles and coating the aggregate rapidly. Aggregate coating in a drum mixer is not a function of asphalt being forcibly mixed, but rather of aggregate particles being engulfed by the foaming, rapidly spreading asphalt.

Phase IV

Most of the moisture has been removed. The aggregate has been coated, and mix temperatures will continue to rise until the desired temperature is reached.

With a low temperature mix, some moisture is retained in the mix. This residual moisture can range from about 0% to 3%, depending on original aggregate moisture content, discharge temperature, and retention time. The retained moisture helps promote compaction of the mix after laydown due to the increase in viscosity it lends to mixes. In most cases, this moisture is lost from the mix in a relatively short time after discharge.

Daily Plant Mix Report

Examples of a "Daily Plant Mix" form and its accompanying gradation work sheets for guidance in completing these forms are included at the end of this section.

The daily plant mix reports are to be submitted to the Construction Bureau on a daily basis through the VAX computer system. The plant mix report is to be submitted from the project to the District through the VAX computer system.

Failing gradation results are to be circled to call attention to the problem areas.

The tons of plant mix bituminous material should be reported to the tenth of ton, and the tons of asphalt should be reported to the hundredth of ton.

The "remarks" space at the bottom of each Daily Plant Mix Form has been made especially large in order that inspectors can write their description of the job happenings on a daily basis. This record can be extremely valuable in reconstructing paving activities while attempting to resolve problems that come to light after the work is done.

Each item of the heading must be completed. Other information must be shown, where applicable, to complete the form. The aggregate temperature for drum dryer plants is to be left blank, as this cannot be obtained from this type of hot plant.

Paving Operation and Inspection

General

(401.03.10)

All of the intricate details of plant inspection, control, and operation to produce a satisfactory mix can be largely wasted if the placement and compaction of the mix are not properly accomplished. The two functions, plant operation and paving operation, must result in an intimately combined and coordinated team effort that results in producing a strong, durable, and smooth pavement.

It is suggested that the road inspector review the various manufacturers' manuals on paver operation and adjustment and study the special provisions and specifications for paving and compaction. The Asphalt Institute's Paving Manual and Hot-Mix Asphalt Paving Handbook provides a great deal of useful guidance on all phases of the paving operation and should be used as a reference manual. However, the inspector should always keep in mind that the contractor's

operation, equipment usage, temperature ranges, and general paving procedure must all be in accordance with the Standard Specifications.

Good preparation involves equipment inspection and determining the paving schedule and paving widths. A thorough check of plans and specifications for that particular job and general discussions between the Engineering Project Manager and the contractor will help establish control at the start of the job. In this way, any corrections that are needed can be made before paving begins and procedures can be set down for correcting or changing as is needed during the course of the work.

Traffic Control

(401.03.9)

Traffic carried on an unpaved shoulder during the paving operation can cause blowing dust to become a traffic hazard. Similarly, on pavement widening projects, the open trench is an unusually dangerous traffic hazard. Paving areas that are not particularly dangerous during the daylight hours may require special treatment during the hours of darkness. The decisions whether to use flaggers and pilot cars, barricades, pavement edge delineators, warning signs, flashing lights, or similar approved traffic control devices must be decided in order to protect and guide the traffic. Special hazards require special treatment, and the placement of guidance devices for unusual situations should receive the traffic engineer's review if there is the least doubt about their adequacy.

All pertinent barricades, warning signs, and other traffic control equipment must be in place and readily visible before any paving can be allowed.

Equipment Inspection

(401.03.2)(F)

General

Each piece of the contractor's equipment are to be checked for their condition, power, obvious defects, and excessive wear in bearings or linkages. Deficiencies in the condition of various pieces of equipment, if discovered and corrected before paving starts, will help in avoiding delays caused by equipment malfunction later.

Pavers

(401.03.2)(F)(1)

The details of the various adjustments to be made on each type of paver are shown in the particular manufacturer's handbook. The inspector should become familiar with the mechanical features on

the type of paver being used so an intelligent appraisal of the condition and adjustment of the machine may be made.

Automatic Screed Control

The automatic screed control consists of a grade reference device, a pendulum or grid-type sensor, and a source of energy for raising and lowering the screed pull arms. Manual thickness adjustments are still used for setting or correcting the position of the screed after deviations have become apparent.

Grade reference devices are of two general types; those used to provide cross slope (transverse control) and those used to provide longitudinal grade control. Cross slope reference is controlled by a transverse beam mounted above and connecting the forward part of the screed pull arms. Longitudinal grade control is provided by an external reference device such as stringlines or wire lines, long ski, floating beam, and/or a 10-foot joint matching ski.

Stringlines must be kept at the proper tension to prevent sagging.

Long skis (40 feet or more) must be straight.

Spring-loaded shoes on floating beams must move freely if the beam is used to average the grade.

When matching adjacent pavements, curbs, and gutter line, a short ski (not less than 10 feet in length) is to be used as a requirement of the specifications.

The energy source for raising or lowering the screed pull arms is a hydraulic or an electrical mechanism. Hydraulic mechanisms have controls for adjusting the rate of response. Slowing the hydraulic response tends to reduce over control, and most manufacturers recommend this practice. Electrical mechanisms usually have a gear box driven by an electrical motor that operates in both directions. Sufficient, continuous electric current is mandatory, and the voltage and cycle meters must be checked daily.

Most pavers have to be started with manual screed controls. Manual control is transferred to automatic control only after the attack angle of the screed has been stabilized at the desired operating speed. It is common practice to start and end the spreading operation at a slow speed, because it may be necessary to use manual control when approaching the terminal point.

When using a slope control sensor, changes in superelevated sections are accomplished by adjusting the slope settings as the paver progresses through the transition. The values for each superelevation must be marked at 25-foot intervals before the work is started, because each adjustment must be made in advance of reaching the reference point. When the slope of a changing

superelevation is not staked, better results will usually be obtained by using the manual thickness controls until the paver reaches the beginning of constant superelevation.

One of the most important aspects of automatic screed control is the sensitivity adjustment. An overly sensitive grade sensor would be constantly producing false control signals that would result in a wavy pavement surface. An undersensitive grade sensor will not detect deviations in the grade soon enough to result in effective control. The sensitivity must be adjusted so that the bounce of the referencing device is not transmitted for correction.

The following check list is provided for paver inspection:

- Engine governor operates properly and engine runs smoothly without missing.
- Slat feeders, hopper gates, and spreader screws are properly adjusted and checked for excessive wear.
- Linkage correctly adjusted on track type machines and the tracks and pins checked for excessive wear.
- All tires on the pneumatic-tired machines inflated uniformly and at the correct pressures. Drive chain checked for correct adjustment and excessive wear.
- Screed plates checked for excessive wear, proper crown, and tilt adjustment.
- Screed heater operating properly.
- Screed extensions are in the same true plane and made flush with the screed bottom.
- Surface of the screed plates is true and in good condition.
- Screed vibrators checked for condition and adjustment.
- Mat thickness and crown controls properly adjusted and in good condition.

Roller Inspection Check List
(401.03.2)(F)(3)

- Drums on steel wheel rollers are smooth and free of flat spots, ridges, or grooves.
- Pneumatic-tired rollers are equipped with smooth tires of equal size, same ply, and be equally inflated. A minimum working weight capacity of 250 pounds per inch width of tire tread is maintained except when used as a breakdown roller, and tire pressure can be regulated while rolling (air-on-the-run).
- Vibratory rollers are operated at speeds that provide not less than eight vibrations per lineal foot of pavement. The vibratory mechanism is capable of being completely shut off when the roller is stopped or is about to stop.

- Amplitude adjustment on vibratory rollers is properly set.
- All rollers are able to start, stop, and reverse smoothly.
- All rollers are equipped with cleaning devices.
- Water sprinklers for drums on steel wheel rollers operate properly.

Trucks
(401.03.2)(F)(2)

The contractor should provide a sufficient number of hauling vehicles to ensure a continuous paving operation, with each haul truck assigned a number before hauling begins. The truck beds should be sprayed with a light coating of an approved solution that will prevent the asphalt from adhering to the truck bed. The solution can be lime water, soap, detergent solution, or a solution of other similar materials. The use of diesel fuel, gasoline, or other oil that may cut the asphalt is not permitted.

Insulated truck beds may be required, or the load covered with a tarpaulin while in transit to prevent excessive loss of heat from the asphalt plant to the roadway. Also, it may be necessary to cover the asphalt load with a tarpaulin to prevent contamination by dust or to eliminate rain from entering the mix.

Hauling Plant Mix

When the haul truck arrives at the paving site, the inspector receives the weight ticket from the truck driver. As each vehicle arrives at the paver, its load is to be inspected visually for any evidence of excessive asphalt content. Evidence of an improper mix must be immediately brought to the contractor's attention. Unusable loads should be rejected, the plant inspector notified quickly, and corrective action taken, if needed.

The asphalt mix temperature may drop excessively due to hauling delays, bunching of the trucks on the road, intermittent operation of the mixing plant, cooling of the mix while in transit, or spreading the materials too far in advance of the finishing machine. Adverse weather conditions could cause a drop in mix temperature. Correct temperature is necessary for adequate compaction.

A truckload of mixture may be rejected for any of the following reasons, which can usually be determined visually:

- Temperature: Too hot or too cold when compared to the temperature viscosity mixing range for the asphalt type being used.

- Asphalt: Too much asphalt slumps the load or runs out of the truck bed. Too little results in no asphalt on rocks, very light color.
- Too much moisture: Bubbles on the coarse aggregates and blisters behind the paver.
- Segregation: Mostly coarse rock with hardly any fines or too many fines with hardly any coarse rocks.
- Nonuniform mixing: Many rocks are not coated.

A fast means of communication should be established between the road inspector and the plant inspector in order to make corrections rapidly at the time they are needed.

Spreading
(401.03.10)

It will be the contractor's responsibility to establish the rate of spreading, but the inspector is to check this rate to ensure the correct depth and yield. This check will also eliminate any errors causing substantial overruns or underruns that may be corrected prior to starting pavement operations. The yield can be checked from the weight tickets at hour intervals throughout the day or other delay periods during the course of the paving work. The road inspector should compute the yield by totaling the tons of plant mix bituminous material received at the end of each hour's production or more often and comparing this with the planned quantity for the width and stations covered. The computing of the tons of plant mix placed for at least every hour's production can prevent large under or overruns of the planned quantities.

Asphalt mixture may be windrowed on the roadbed ahead of the paving machine, picked up by mechanical means and placed in the paver hopper, or dumped directly into the paver hopper from the hauling vehicle. The windrowing of material ahead of the paving machine does have the advantage of permitting a more continuous operation of the paver, however the inspector should make frequent temperature checks to ensure that the material in the windrow is not cooling too rapidly.

Any material spilled when loading the paver directly from the truck must be cleaned up immediately to prevent the formation of a bump.

Continuous operation is one of the most important factors in obtaining a smooth pavement. Starting and stopping with paver leaves an irregular surface. Paving machine operators who operate the paver faster than plant production will cause a jerky stop-and-go operation. Do not allow this. The ideal paver speed is that which will give a smooth, nearly continuous process with a minimum of stops while waiting for trucks.

Some common difficulties encountered that can be traced to improper paving operation or incorrect machine adjustment are listed below:

1. A surface with short, choppy waves can be caused by poorly adjusted tracks or drive chains, the truck driver setting brakes too tight, or excessive paving machine speed.

2. A surface with long waves can be caused by excessive variation in the quantity of mix carried in the auger box ahead of the screed, rolling too early, rolling too fast, or over controlling the screed.

3. Mix with an open surface can be caused by improper adjustment of the screed, rough screed plate, or too fast paving machine speed.

4. A varying surface texture may be caused by insufficient mixing, overmixing, overheating of the mix, segregation of the mix, or a worn or damaged screed plate.

5. Bleeding patches on the surface can be caused by too much asphalt, asphalt not uniformly mixed, or excessive moisture in the mix. Excessive moisture in the mix is also apparent when small bubbles appear on the coarse rocks in the mix, the mix slumps in the truck beds, or bubbles or blisters appear immediately behind the paver.

6. Irregular rough spots in the pavement can be caused by rollers standing on the fresh surface, abrupt reversing of the roller, trucks backing into the paver, or poor workmanship at transverse joints.

The use of a motor grader in smoothing and spreading the mixture is permitted only in areas that are inaccessible to the paving machine or for leveling and correcting irregularities in the existing surface before placing the first full course of asphalt material.

Compacting the Mix
(401.03.12)

Rolling should start as soon as possible after the material has been spread by the paver. During rolling, the roller drums should be kept moist with only enough water to avoid picking up the material. Rollers should move at a slow but uniform speed with the drive wheel nearest the paver. Rollers should be in good condition, capable of being reversed without backlash. If rolling causes displacement of the material, the affected areas should be loosened at once and restored to the original grade with loose material before being recompacted. Heavy equipment including rollers should not be permitted to stand on the finished surface before it has thoroughly cooled.

A pattern of rolling that will provide the most uniform coverage of the lane being paved should be used. Rollers are produced in varying widths, and any single recommended pattern that applies to all of them is impractical. For this reason, the best rolling pattern for each roller being used should be worked out and followed to obtain the most uniform compaction across the lane. Whether using

steel tandem rollers or vibratory rollers, the rolling pattern should be developed in the same manner as for the breakdown rolling. This pattern should be continued until the desired compaction is obtained.

Finish rolling is done solely for the improvement of the surface and should be accomplished while the material is still warm enough for the removal of all roller marks.

Joints and Surface Smoothness
(401.03.11)

When paving next to Portland cement concrete, the concrete edge should be coated and the mix crowded tightly against the concrete face. After compaction, the asphalt surface should be just a fraction of an inch higher that the concrete surface.

Longitudinal Joints. The majority of longitudinal joints are formed cold. Two joint forming methods are used: (1) The paver should be adjusted so that material overlaps slightly into the finished lane and is placed slightly high so the correct thickness will result when compacted. With this method the first lane is rolled over the edge. (2) A strip about 2 inches wide is left by rolling and compacting with rolling of the adjacent lane. This method works extremely well in hot weather or when the material at the joint faces is hot.

A tapered longitudinal joint is used on many plant mix projects. The longitudinal joint is formed with a beveled slope of 5:1 or flatter at the joint side of the lane to be later matched with an adjacent lane. The beveled slope eliminates the vertical drop-off between the paved and unpaved portions of the traveled way. The advantages of this type construction are greater safety to the public by eliminating the vertical longitudinal joint and not needing to have the lanes paved to the same location at the close of work each day.

Transverse Joints. The use of a board (bulkhead) of the proper thickness is permissible, but it should be checked with a straightedge before the joint is completed. Bulkheads used in low stability mixes are apt to shove ahead when rolled. If shoving does occur, the mat thickness will be too thin and the material will have to be trimmed as though no bulkhead was used.

When spreading operations are resumed, the paver screed should be heated and the depth set so that finished compaction will provide a smooth junction of the new and the old material. Freshly made joints should be thoroughly compacted by normal rolling and cross rolling.

Care should be taken when doing any handwork in constructing transverse joints to ensure that coarse material is raked and wasted.

Surface Smoothness
(401.03.14)

The inspector should check the surface of each course thoroughly with a ten-foot straightedge. Irregularities that are detected should be corrected immediately by removing or adding material. Corrections made while the mat is warm will not be as noticeable as those made later. The final course of plant mix can usually be placed much more uniformly if the required smoothness is obtained in the first course. Corrections are more easily made in the first course than they are in the final course.

After final rolling of the finished course is completed, the surface should again be checked, areas that exceed the surface tolerance should be marked, and corrections made before the work is accepted. Sometimes corrections can be made by cross rolling, but if not, the areas are to be removed and replaced to meet the proper surface smoothness.

Paving Inspector's Check List

- All equipment thoroughly inspected.
- Screed checked with stringline or straightedge.
- Leading edge of screed has 1/16" to 1/8" more crown in leading edge than on trailing edge.
- Traffic control in place and provides safe travel for motorists.
- Roadbed properly prepared before paving begins.
- Tack coat applied to all surfaces that will come in contact with the fresh mix before paving begins.
- All phases of paving operation discussed with contractor.
- Paver guidelines have been set properly.
- Longitudinal and transverse joints checked for smoothness and appearance. Corrections made where deficiencies exist in smoothness.
- Mix temperature checked frequently.
- Mat behind paver continuously inspected for signs of roughness or nonuniform mixture.
- Spread is checked frequently and records kept of truckloads used each day.
- Daily totals of quantities reconciled with plant inspector as soon as practical.
- Traffic control inspected at the end of each work day.

Records and Documentation
(401.04)

Asphalt Record

Because not all of the asphalt delivered to a project is actually used, a separate asphalt record should be maintained. The record should show the total quantity of asphalt received and the quantity of asphalt on hand at the close of the shift. The difference in these totals is the quantity of asphalt disposed of by the contractor, which includes the asphalt used on job, the asphalt that may have been wasted, and the asphalt used by the contractor for other purposes (private sales, etc.). It is a good practice to have the contractor's representative sign a record of asphalt wasted and taken over for use by the contractor.

The example asphalt record shown at the end of this section satisfies the need, but the headings could vary to suit any job. The date, certificate number, and quantity of asphalt received is recorded. Observations of asphalt on hand are recorded. The individual quantities of asphalt wasted and taken over by the contractor are recorded. Finally, the quantities to be paid for are placed in columns that designate under which portion of the contract the asphalt is to be paid. The actual use of the asphalt should be detailed in the records indicated by these headings.

Maintaining this type of record provides documentation of the disposition of all asphalt shipped to the project, possibly resolving disputes over pay quantities.

Hydrated Lime and Mineral Filler Record

Hydrated lime or mineral filler is being used frequently to improve the quality of plant mix bituminous surfacing material, which requires good records to ensure that the proper amount of lime or filler is being incorporated into the plant mix bituminous material.

Seal Coat
(409)

General
(409.01)

A properly constructed seal coat can increase the life of the pavement, and increase safety by:

- preventing the entrance of moisture;
- reducing the circulation of air throughout the mat, which lessens the amount of oxidation;

- providing a more skid resistant surface;
- rejuvenating a weathered surface;
- delaying further raveling; and
- providing more light reflection from headlights for better visibility at night.

Equipment
(409.03.3)

Spreader
(409.03.3)(D) and (410.03.1)(C)

Before the spreader is loaded, the inspector should examine the scalping screen to ensure that the openings are uniform. Any large openings have to be repaired so that large material will not block the gates.

The inspector should direct the contractor to operate the gates before the spreader is loaded. Each gate should open and close at the same time. Any gate not operating properly must be repaired so that a uniform application of material will be applied.

Distributor
(409.03.3)(A) and (410.03.1)(A)

Before application of material, the inspector should examine all the nozzles to ensure that they are clean and angled in the same direction. Clogged nozzles and/or misaligned nozzles will result in a non-uniform application.

Application
(409.03.8)

Bituminous Material
(409.03.8)

The bituminous material is applied with a distributor as soon as possible after the roadway surface has been swept clean. The rate of application is usually about 0.30 gallon per square yard. This rate allows for a small amount of material to be absorbed by the surface. The rate should be increased if the surface is dried out. The rate should be decreased if the surface is rich in asphalt content.

Cover Material
(409.03.9)

The application rate for the cover material is about 20 pounds per square yard. The best way to determine if the proper amount of material is being applied is to visually inspect the surface. Ideally, the aggregate will not be laying one on top of another, and the space between the aggregate will be about the size of the head of a pin.

When emulsions are used, the cover material should be in place within one minute after the emulsion was applied. This is important because a film will form on the emulsion after a minute or so preventing the aggregate from embedding in the material. When this happens, the cover material will not be held in place. NOTE: A film is forming when the emulsion turns from brown to black. The cover material has to be applied before the emulsion turns black.

When using High Float, the one minute criteria is not in effect. You must wait awhile before applying the chips — about ten to twenty minutes.

The speed of the spreader should be such that the aggregates do not roll when they hit the surface. Build-up of bituminous material on top of the aggregate indicates that the spreader speed is too fast.

Rolling
(409.03.12)

As soon as the bituminous material has a definite set or hardening, rolling should be discontinued. Additional rolling at this point can dislodge the cover material.

Records
(409.04)

The following information should be recorded by the inspector on a daily basis as appropriate:

- Weather conditions.
- Bituminous material and aggregate used.
- Asphalt samples taken.
- Beginning and ending stations.
- Equipment used.
- Delays, such as equipment breakdowns.

STATE OF MONTANA
Department of Highways

DAILY PLANT MIX FORM
(To be accompanied by Density Form MBP No. 100)

Project No. IR 15-4(53)217 & IR 15-4(55)200 Report No. 2 Date 6-13-84

Termini Helena North & Wolf Creek Canyon Contractor Hilde Construction Co.

WEATHER: Condition Partly Cloudy Air Temp: AM 52° PM 65°

Type of Plant Boeing Drum Dryer Grade of Mix "B" Bit. Material 120 - 150

No. of Lifts 1 Total Thick. 0.15

Asph. Supplier Simmons Specific Gravity 1.021 Wt. (lbs/Gals) 8.5027

Cert. Nos. 1532, 1539, 1584, 1255, 1254, 1253 & 1259

PLANT Time Start 6:45	Gross Time 10 Hrs. 15 Min.	Net Time 7 Hrs. 39 Min.
HOURS Time Stop 5:00	Time Delay 2 Hrs. 36 Min.	Avg. Hr. Prod. 478

SPOT Time	7:30	8:30	9:30	2:00	3:30	4:30	
CHECKS % Asph.	6.34	6.11	6.73	6.86	6.86	6.83	

TEMPERATURES Viscosity Mixing Range 286 ~ 291

Time	7:30	8:30	9:30	2:00	3:30	4:30			
Aggregate									
Asphalt	289	290	289	301	304	285			
Mix at Loading	275	270	275	260	270	267			

Brkdwn. Rolling (Average Temp.): 199°

Completed Rolling (Average Temp.): 180°

AGGREGATE REPORT: To be reported to the tenth of a ton.

COARSE	TONS USED			Plan Tons	PLACED	
	Today	Previous	To Date		Station - Station	Lift - Lane
Apprs.						
Ramp	0	401	401	401		
TT: Safety Area	0	728	728	416		
Leveling	0	2636	2636	3637		
1st Lift	3611	55455	59099	58978	111+50 ~ 211+502	S.B. Lt.
2nd Lift						
Total	3611	59220	62861	63232		

ASPHALT REPORT: To be reported to the hundredth of a ton.

Used Today 224.849 Tons Used Previously 3398.942 Tons Used to Date 3623.791 Tons

MARSHALL COMPARSIONS:

	Stabl.	Flow	% Voids	Density
Design Value	2288	13	4.2	144.1
Marshall Value	1723	16	3.8	144.7
Date	6-13-84			

PERCENT ASPHALT:

Design	Job Mix	Daily Average
6.5%	6.5%	6.58%
Date	6-13-84	

HYDRATED LIME OR MINERAL FILLER USED

Mix Design Recommended ____ % Used Today ____ %

Today Tons ____ Previous Tons ____ Total to Date ____

Type ____ Brand ____ Source of Supply ____

REMARKS The difference between Stab. & Oil Totalizer is only 0.1% for day. Having problems with Aggregate Tests.

Arthur Fergerson
Plant Inspector

MBF Form No. 98-C
(Rev. 1-83)

STATE OF MONTANA
Department of Highways

DAILY PLANT MIX FORM

(To be accompanied by Density Form MBF No. 100)

Project No. IR 15-4(60)190 Report No. 18 Date 6-14-84

Termini Jefferson Co. Line-North Contractor Empire Sand & Gravel

WEATHER: Condition P. Cloudy & Warm Air Temp: AM 50° PM 75°

Type of Plant Boeing 400 Drum Grade of Mix "B" Bit. Material 85-100

No. of Lifts 2 Total Thick. 0.25

Asph. Supplier Continental Specific Gravity____ Wt. (Lbs/Gals)____

Cert. Nos. 56-3241, 56-3243, 56-3255, 56-3259 & 56-3260

PLANT HOURS	Time Start 8:00 AM	Gross Time 10 Hrs. 15 Min.	Net Time 10 Hrs. 15 Min.
	Time Stop 6:15 PM	Time Delay 0	Avg. Hr. Prod. 370 Tons

SPOT CHECKS							
Time	8:15	10:30	12:15	2:30	4:50		
% Asph.	5.80	5.80	5.77	5.82	5.79		

TEMPERATURES Viscosity Mixing Range 265~292

Time	8.25	10.20	12.20	2.45	5.00					Brkdn. Rolling (Average Temp.) 245°
Aggregate										
Asphalt	315	320	318	323	328					Completed Rolling (Average Temp.) 200°
Mix at Loading	284	281	289	279	277					

AGGREGATE REPORT: To be reported to the tenth of a ton.

COARSE	TONS USED			Plan Tons	PLACED	
	Today	Previous	To Date		Station - Station	Lift - Lane
Apprs.						
Ramp	695.6	562.1	1257.7	1454	21+73~158+52 Right E.B. Line	2nd S.B. 22' Pass Lt. Lincoln Interchange
Guard Rail Widening	5.4	90.4	95.8	96		
Leveling		4212.3	4212.3	4096		
1st Lift		25823.5	25823.5	25835		
2nd Lift	3090.7	27251.8	30342.5	30840		
Total	3791.7	57940.1	61731.8	61721		

ASPHALT REPORT: To be reported to the hundredth of a ton.

Used Today 206.34 Used Previously 3145.55 Used to Date 3351.89

MARSHALL COMPARSIONS:

	Stabl.	Flow	% Voids	Density
Design Value	2057	14	8.1	151.5
Marshall Value	2022	13	2.7	152.4
Date 6-4-84				

PERCENT ASPHALT:

Design	Job Mix	Daily Average
5.75	5.75	5.81
Date 5-21-84		

HYDRATED LIME OR MINERAL FILLER USED

Mix Design Recommended 1.0 % Used Today 1.0 %

Today Tons 35.5 Previous Tons 537.3 Total to Date 572.8

Type II Brand Low Alkali Port. Cement Source of Supply Kaiser Cement Corp.

REMARKS All Plant Mix Produced Today used on Project.

Donald F. Doner
Plant Inspector

MBF Form No. 98-E
(REV. 1-83)

WORK SHEET FOR AGGREGATE GRADATIONS-DRUM DRYER PLANTS
(To Accompany Daily Plant Mix MBF Form No. 98-C)

Pit Lab No. 567631, 568010-12 J68791-794 Project: IR 15-4(60)190 Daily Plant Mix Report No. 18

County Lewis & Clark Designation Jefferson Co. Line-North Date 6-18-84

Location S.E.¼ Sec. 18 T.10-N R.3-W Section 18 Township 10 N Range 3W

Job Mix	Spec.	Sieve Size	TEST NO. 96 Stationing 181+50 Lift 2nd Lane S.B. (Lt.) Wt. Ret.	Wt. Pass	% Pass	TEST NO. 97 Stationing 153+00 Lift 2nd Lane S.B. (Rt.) Wt. Ret.	Wt. Pass	% Pass	TEST NO. 98 Stationing 183+10 Lift 2nd Lane S.B. (Lt.) Wt. Ret.	Wt. Pass	% Pass	Sieve Size
		1 1/2"										1 1/2"
		1"										1"
100		3/4"		25.06	100		27.69	100		30.41	100	3/4"
91	9999	1/2"	1.50	23.56	94	1.67	26.02	94	1.85	28.56	94	1/2"
78	6002	3/8"	4.76	18.80	75	5.51	20.45	74	5.80	22.76	75	3/8"
52	4999	4M	6.23	12.57	50.2	7.10	13.35	48.3	7.75	14.93	49.1	4M
----	----	Wash	Before 103	After 123		Before 190	After 219		Before 191	After 212		Wash
35	2994	10M	138	345	36	134	346	35	139	342	35	10M
16	11-21	40M	175	170	18	174	172	17	171	171	17	40M
		80M	56	114	12	53	119	12	54	117	12	80M
7	5-9	200M	40	74	7.7	39	80	8.1	39	78	8.0	200M
			Stockpile Moisture % Fracture 92 % Mix Moisture %			Stockpile Moisture % Fracture 93 % Mix Moisture %			Stockpile Moisture 1.9 % Fracture 92 % Mix Moisture %			

Remarks:

Tested By: Michael Arvish E.T.

MBF Form No. 98-E
(REV. 1-83)

WORK SHEET FOR AGGREGATE GRADATIONS-DRUM DRYER PLANTS
(To Accompany Daily Plant Mix MBF Form No. 98-C)

Pit Lab No. 568101 Project: IR 15-4(59)217 IR 15-4(55)200 Daily Plant Mix Report No. 2

County Lewis & Clark Designation Helena North & Wolf Cr. Canyon Date 6-13-84

Location SW¼ NW¼ SE¼ NW¼ Section 9 Township 13N Range 4W

Job Mix	Spec.	Sieve Size	TEST NO. 12 Stationing 184+00 - 186+60 Lift 1st Lane S.B. Wt. Ret.	Wt. Pass	% Pass	TEST NO. 13 Stationing 659+00 Lift Lane S.B. Patching Wt. Ret.	Wt. Pass	% Pass	TEST NO. 14 Stationing Lift Lane Wt. Ret.	Wt. Pass	% Pass	Sieve Size
		1 1/2"										1 1/2"
		1"										1"
100		3/4"	0	28.63	100	0	35.07	100	0	25.80	100	3/4"
87	80-95	1/2"	1.79	26.84	94	3.19	31.88	91	1.69	23.71	92	1/2"
77	65-80	3/8"	4.44	22.40	78	6.71	25.17	72	3.86	19.85	77	3/8"
56	40-60	4M	7.31	16.09	56.2	8.24	16.93	48.3	5.51	14.34	56.5	4M
----	----	Wash	Before 636	After 556		Before 570	After 494		Before 537	After 466		Wash
41	35-47	10M	156	480	40	96	474	40	122	415	44	10M
19	13-25	40M	285	195	16	264	210	18	242	173	18	40M
		80M	65	130	11	74	136	12	58	115	12	80M
8	5.5-10.5	200M	41	89	7.5	47	89	7.5	36	79	8.3	200M
			Stockpile Moisture 3.7 % Fracture 100 % Mix Moisture .03 %			Stockpile Moisture 3.7 % Fracture 100 % Mix Moisture .03 %			Stockpile Moisture 3.7 % Fracture 100 % Mix Moisture .03 %			

Remarks:

Note: 4M Was run through shaker twice

Chapter Seven

Rigid Pavement

General

The construction of concrete pavement is a highly mechanized operation requiring a thorough knowledge of equipment, methods, materials and their proportioning. Paving inspectors should be very familiar with the plans, specifications, special provisions, construction details and order of the work.

Before the start of paving operations, a meeting shall be held (501.03.2) with the contractor's supervisory personnel and the Engineering Project Manager and inspection staff to discuss: Material sources, handling of materials, plant site, equipment, methods of operation, scheduling and the specification requirements. A summary of this meeting should be written by the Engineering Project Manager and copies sent to the contractor and District Construction Engineer.

Some essentials to observe in producing a high quality concrete pavement are:

- Proportioning of aggregate and cement
- Absolute control of the water content of the mix
- Preventing segregation in the concrete
- Adequate number and proper spacing of finishing equipment to handle production
- Properly trained equipment operators and finishers
- Proper curing
- Proper sawing and jointing

Preparations Before Placing Concrete

(501.03.8)(B)

Concrete pavement is almost always placed upon bituminous surfacing, lean concrete, or cement treated base. The base should be carefully inspected for visible indication of surface defects and design strength properties before allowing placement of the concrete pavement.

Paving Equipment Inspection
(501.03.8)

Before any concreting work is done, all equipment should be checked. It is necessary to check for compliance with the specifications for mechanical conditions, capacity, and to make certain that all necessary equipment is on the job and available for use. It should also be a matter of course to ensure that plant production, paver capacity and the number of hauling units are matched to allow uniform placement speed.

Batching Plant Equipment
(551.03.3)(C)

Hoppers and bins should be set level and loaded for at least 24 hours before calibrating. Bins should be carefully loaded to avoid segregation, contamination or intermingling of the different materials.

The weighing hopper should empty completely and be large enough to contain the batch being weighed without overflow or "coning" against the bottom hopper.

The working parts of the weighing unit (knife edges, shackles, weighing arms) must be free of avoidable friction, in good condition, protected from falling or adhering material and be readily accessible for inspection. There should be no attachments to the scales or weigh hopper which might restrict the free movement of any part of the weighing mechanism or cause any inaccurate weighing during actual operation.

All scales should be checked at regular intervals to ensure that the designated quantity of material is actually being delivered. Zero balancing should be checked twice a day with the weigh hopper empty. Sensitivity should be checked by balancing the scales under no load, then suspending standard 50-pound weights from the weigh hopper. Ten 50-pound weights are added, one by one, observing and recording the scale reading. Then these weights are replaced by enough material to give the same scale reading.

The quantity of water discharged into the drum may be checked against the gauge reading by disconnecting the water line, diverting the flow into a container and weighing the quantity discharged at various settings. The quantity of water should be large so that small quantities of water remaining in the hose and small measurements will not drastically affect the results.

Materials
(501.03.3 and 551.03.2)

The following listing of references to the Standard Specifications is provided for quick assistance to Engineering Project Managers and inspectors:

- Contractor's responsibility for materials — 501.03.5
- Stockpiling of aggregates — 303.03
- Material Acceptance — 501.03.5
- Price Adjustment — 105.03.2 and 501.03.5(C)

Placing Concrete — Stationary Side Form Method

(501.03.8)(B)

In this method, stationary forms are placed in advance of the paving operation. Mechanical spreaders ride the forms and spread the concrete with either a helical screw or a blade. The blade travels back and forth between the forms whereas the screw movement is rotational, either forward or reverse. The elevation of blade or screw may be adjusted and set to properly distribute concrete.

The screed is located behind the blade or screw. The purpose of the screed is to strike of and partially consolidate the concrete. The elevation of the screed is usually set somewhat higher than the desired finished elevation so that after consolidation the surface will have the correct elevation. A controlled excess of fresh mix should be kept ahead of the spreader to avoid starving the strike-off screed.

To compensate for superelevations or cross slope, the elevation of the screed is adjusted. When these adjustments are anticipated and made in small increments, the finished surface will be free from abrupt changes. Normally, the front screed is tilted down slightly so that the leading edge is 0.01 to 0.03 foot below the trailing edge. The rear screed is tilted up slightly so that the leading edge is approximately 0.02 foot above the trailing edge.

Proper elevation and cross slope for the screeds of this finisher are determined through the use of a straightedge laid across the pavement and side forms after the final pass. The surface of the fresh concrete should be above the plane of the side forms by an amount sufficient to provide for slump and subsidence during finishing which varies with different mixes. Experience with the mix in use will indicate the most satisfactory settings.

The tamper bar should be adjusted so that it penetrates approximately 0.03 foot into the fresh concrete at the bottom of its stroke. Usually two passes of the tamping-screeding finisher are adequate to tamp and shape the pavement surface. There are occasions, however, when additional passes become necessary. The number of passes necessary can be judged by observing the uniformity of the roll of excess mix carried on the rear screed as the machine operates. The roll of material should be only a few inches high and be reasonably uniform across the full width and should not vary appreciably during the entire final pass.

Tamping-screeding finishers should be provided with adequately maintained scrapers at each wheel to prevent intrusions of mix between them and the top of the forms.

Finishing Concrete
(501.03.8)(C)

Bumps and other deviations remaining in the surface after spreading and screeding must be cut and floated out as early as possible while the concrete is still very plastic and workable. Initial passes of float finishers should follow immediately after the tamping-screeding finisher, and should be performed as rapidly as possible.

Manipulation of the surface of the concrete during the period of greatest bleeding, if there is free water present, should be held to a minimum. Floating or screeding the surface in the presence of excess water results in leaching the cement which produces low strength surface mortar of inferior abrasion resistance and durability.

Water should be added during float finishing only to maintain proper moisture for adequate curing and only in the form of mist. Adding water to make more grout for floating is not permitted. Generally, the difficulty in floating is caused by too much delay in the finishing operation, and the finish floating should be performed earlier. Float finishers should be provided with adequately maintained scrapers at each wheel to prevent intrusion of mix between them and the top of the forms.

Joints
(501.03.13)

Wire mesh, bar mats or continuous reinforcing are not often used in Montana. When these materials are required, they should be kept clean and undamaged before use and be free of dirt, oil, paint, grease and excessive rust when placed.

Dowel supporting assemblies are sometimes required for transverse joints. These assemblies must be laid out and marked in such that the exact centerline of the assembly can be re-established. Generally they are held in correct position by the use of metal stakes or pins that are left in the pavement. Small wires used for holding dowel supporting assemblies together during fabrication and shipment should be cut after installation. Dowels should be free moving with an approved dowel cap or sleeve in place and coated with an approved lubricant.

Tie bars installed across the centerline should be parallel to the surface and at right angles to the centerline. Unless an approved mechanical device operating immediately behind the spreader (or behind the strike-off for slipform paving) is used for the installation, they must be installed ahead of placing the concrete and held securely in position.

Keyways for multiple lane paving must be held in proper position against the face of the roadway forms. Tie bars or hook dowels must be correctly spaced and securely fastened.

Sawing is to be accomplished as soon after the concrete has hardened as can be done without tearing or raveling and before random, uncontrolled shrinkage cracks develop. The timing of joint sawing is identified in the specifications. However, the Engineering Project Manager should closely examine the sawing operation to ensure that the timing is correct. The proper time for sawing will be different from one project to the next.

Green concrete can often be sawed as successfully as well-aged, hardened concrete. The proper time to saw weakened plane joints, however, varies widely from 10 hours to many days after the concrete is placed, depending upon the function of the particular joint and upon the condition of the concrete. Control joints, because of their function to relieve early drying-shrinkage stresses, must be cut as soon as the concrete has hardened enough to support the saw equipment, providing that cutting does not disrupt the concrete.

Intermediate joint sawing is delayed for at east 24 hours to allow the concrete to develop additional strength to better resist sawing stresses. Excessive raveling at the top edges of the saw cut and washing of mortar from the faces of the cut under the action of the saw indicates that the cut is being made too early.

After stresses in the concrete develop to the level of causing volunteer cracks, the slab is in tension and further sawing will result in cracks ahead of the saw cut. When these conditions are encountered, the sawing should be discontinued until the following morning when temperature rise relieves the tensile stress. If daylight hours remain and the concrete is sufficiently hardened, the sawing operation should be moved to greener concrete, in which stresses have not yet reached a point where volunteer cracking results.

Sealing joints with approved joint sealer materials is to be done before opening to traffic and after the joints, whether sawed or formed, have been thoroughly cleaned and are surface-dry. Heated joint material, if used, must be stirred to avoid localized overheating and must have its temperature checked continually to ensure compliance with the manufacturer's recommended temperatures. Joint sealing should be done carefully to avoid spillage on the concrete surface. All material spilled on the surface should be removed.

Removing Forms — Side Form Method
(501.03.8)(B)(2)

Removal of side forms requires good judgment because weather and temperature will affect this operation. Unless sawing is necessary before concrete has set for at least 12 hours, the forms shall not be removed before this length of time. In all cases, the concrete should have hardened to the extent that spalling or other damage will not occur. Immediately upon removal of forms all honeycomb must be patched and the pavement edges cured in an approved manner.

Placing and Finishing Concrete — Slip Form Method
(501.03.8)(A)

Pavement Base

The use of the pavement base by batch trucks and mixers, results in the accumulation of dust and other contaminants. This condition must be corrected immediately before placing concrete. It is usually satisfactory for the contractor to shovel away loose material and to dampen the base with water after the mixer has passed by to offset the drying effect of the dust.

It's important that the specified depth of concrete be maintained over the entire roadway. Inspectors should ensure that the subgrade elevation is correct. The elevation of the completed subgrade can be readily checked at staked intervals with levels, templates, etc. The elevation of the completed subgrade at intervening locations along line should also be checked to ensure that no high subgrade exists.

Control Guide Wires

The guide wires, controlling the slip-formed pavement grade, perform a function similar to that of side-forms used in conventional concrete paving. The pavement surface can be no more smooth or true in cross section than the accuracy to which the control wire has been set and maintained. The wire should be carefully checked against the survey stakes for alignment and grade.

A final check and adjustment of the wire should be made immediately before paving by sighting along the wire to detect and eliminate any irregularities in line and grade.

Spreading and Finishing — Slip-Form Method
(501.03.8)(A)

Slip-form machines are designed to receive concrete either on the subgrade within an extension of the attached side forms or in a receiving hopper. Hoppers serve the purpose of laterally distributing the fresh concrete to the main screed. Concrete discharged into such a hopper should fall less than five feet to avoid segregation.

When concrete is placed on the subgrade in advance of the slip-form paver, it is very important to provide a uniform quantity of concrete for the strike-off blade. Piles of dry concrete cause the paver to "float" or lift above the true elevation which results in a high area.

Final Finishing
(501.03.8)(C)

Final finish on slip-formed pavement is generally accomplished by a self-propelled tube finisher. This equipment essentially acts as a straightedge to remove surface irregularities and as a float to seal the surface. The application of water in using this machine should be in the form of a fog or mist and shall be the minimum necessary to secure a satisfactory finish.

Texturing
(501.03.8)(C)

The most important facet of texturing is timing. The grooves should be formed while the concrete is still plastic, but before tearing or raveling will result from texturing. Inspectors should ensure that the tines are all in place, evenly spaced, and free from build-ups of hardened concrete. The depth of the grooves should also be checked. If the grooves are too shallow they do not last long enough and do not provide drainage necessary to prevent hydroplaning. If they are too deep the surface is weakened and wears excessively.

Check List

The following check lists are provided for each person assigned to a paving project.

Batch Plant Inspector

- Production, handling and stockpiling of aggregates inspected
- Plant equipment and operation handbooks reviewed
- Plant equipment inspected for compliance with specifications
- Calibrations and checks observed and documented
- Cement certifications received and recorded
- Approvals for air agent and admixtures verified and recorded
- Scale weight settings inspected
- Mix design adjusted for aggregate moisture changes
- Actual batch weights observed and recorded periodically
- Slab Inspector contacted to record batch weights of loads sampled for unit weight test
- Records maintained of batches produced each day

- Major parts of plant inspected periodically (mixer, weigh bins, admixture dispensers, water meters, drum revolutions, mixing time)
- Cement cut-off checks conducted periodically
- Aggregate batch handling practices inspected
- Returning non-agitating haul units inspected for concrete not discharged
- Diary maintained recording instructions to contractor, unusual actions taken, time of starting and ending, lost time due to breakdown, weather, and contractors' forces
- Samples obtained and tests performed on aggregates as required

Slab Inspector

- Inspection and testing activities coordinated at paving operation
- Paving equipment handbooks reviewed
- Paving equipment inspected for specification compliance
- Hauling equipment inspected for specification compliance
- Condition of base ahead of paver inspected
- Visual check of grade control string-line made immediately ahead of paver
- Concrete properly deposited
- Concrete slump checked frequently
- All vibrators in place and operating
- Vibration stops when paver stops
- Tie bars properly spaced and placed at correct depth
- Concrete behind paver inspected for excessive moisture
- Concrete behind paver is smooth and free of voids
- Tube finisher follows closely behind paver
- No water added to surface other than in a fine fog or mist, and no more water added than necessary
- Texturing operation does not tear surface
- Texturing done as soon as possible
- Curing compound applied as soon as surface water disappears
- Curing compound applied at the proper rate and covers all exposed concrete

- Construction joints checked with a straightedge
- Starting and ending station recorded each day
- Sampling and testing for slump, entrained air, cylinders, test beams, and unit weight supervised
- Installation of plastic strips for joints installed vertically and straight at the proper depth
- Diary maintained to include instructions to contractor, actions taken, daily starting and ending time, lost time, and contractor's forces

Sawing Inspector

- Saw cuts checked for proper depth and width
- Sawing inspected for excessive raveling, washing and tearing of concrete and for random cracking
- Sawed joints are completely cleaned
- Curing compound damaged by sawing operations replaced

Joint Seal Inspection

- Joint is completely clean and surface dry
- Lab approvals and certifications for materials verified
- Pavement temperature checked
- Sealant temperature checked for compliance with manufacturer's recommended heating and application temperature range
- Joints are filled to proper depth and excess scraped from pavement
- Record kept of beginning and ending station each day

Chapter Eight

Bridge Construction

Foundation Construction

(209) and (552.03.2)

General

Spread footings or pile footings make up the majority of foundations used on bridges in the State. Spread footings consist of concrete or reinforced concrete pads placed on undisturbed soil. Pile foundations are generally a concrete pad placed over timber or steel bearing piles driven to practical refusal.

Core Logs

The load supporting or bearing capacity depends on the type of soil. Bridge foundations are designed to transfer the load of the bridge to the soil. The safe load carrying capacity is generally determined from information obtained from core holes drilled in the area of the bridge. The Department obtains this information for design purposes.

A basic understanding of core log information is helpful for inspection of foundations. Each core log generally contains the following information:

1. Location of hole relative to bridge substructure units.
2. Elevation at surface.
3. Ground water elevation.
4. Elevation of changes in soil type.
5. Sampler tube blow counts.
6. Graphical representation of material encountered.
7. Word description of material encountered.
8. Standard note regarding blow counts and interpretation of information shown.

Probably the two items most used in determining bearing capacity for design are the type of soil and the sampler tube blow counts. The type of soil is determined by periodically removing core samples from material below the bottom of the bore hole. This is done with a sampler tube. The blow counts shown on the log are the number of blows it takes to drive the sampler tube 6 inches with a 140 pound hammer dropping 30 inches. The core samples are sent to the Helena lab and are stored there until the project is complete.

The information shown can only represent the conditions found in that hole. With proper training and experience, the core information may be interpreted to project conditions that possibly may be encountered between the holes.

The sole purpose for the cores is to permit the bridge foundation to be designed. That is why the plan note advises that the Department will assume no responsibility for variation in interpretation of classes of material. Field personnel must avoid providing any interpretation of core log information particularly to prospective bidders. However, field personnel may request information for additional construction or core data from previous projects to assist bidders.

Foundation construction is the source of the most frequent and the costliest of contractor claims. Many of these claims are based on alleged variations from core log information. It is vital to maintain comprehensive records of materials encountered during foundation work when a written intent to file a claim is received. The Construction Bureau must be notified promptly when drastic changes from core log information are noted under these circumstances.

Excavation

(209.03.1)

The first step in foundation construction is excavating to plan base of footing elevation. Usually a contract item for structure excavation is provided for this purpose. Structure excavation may begin at natural ground surface or from some designated point in an embankment or cut slope. The area in the vicinity of the bridge must be graded to the limits designated on the plans or in the special provisions before structure excavation is staked and begun. Structure excavation for bridge substructure units located in embankments is a continuing problem area. These must be constructed to limits designated on the plans or the standard drawings before structure excavation is permitted.

Excavations for foundations must be sloped or shored in accordance with OSHA standards. Department personnel are specifically prohibited from entering any excavation not properly sloped or braced. Personnel should be on the lookout for any signs of distress such as excessive bending or buckling before entering a cofferdam. An adequate means of rapid exit, such as a ladder, is required.

Pay limits for structure excavation are defined in the Standard Specifications. Excavation outside these limits for OSHA compliance, ease of construction, or other reasons, will not be measured for payment. In some cases, excavations within a specified limit for environmental or special reasons will

be noted on the plans or in the special provisions. An unsafe excavation may not warrant inspection by Department personnel and require corrective action by the contractor.

Structure excavation is generally done with a backhoe or a clamshell bucket. Before reaching plan grade, teeth must be removed from buckets to prevent disturbing material below the footing. It is a good practice to remove the last few inches by hand. In the event foundation material is disturbed or over excavated, the contractor will be required to correct it at his expense in accordance with Article 209.05.

Moisture can alter a soil's bearing capacity. It is necessary to protect dry land foundation excavations from precipitation and runoff. They must also be backfilled as soon as possible, or according to the special provisions.

Payment for structure excavation includes full compensation for backfilling. Any backfill that will be any part of or carry any part of the roadway embankment must be done in accordance with the Standard Specifications. This requires bringing backfill to the specified moisture content and compacting to specified density. Arrangements should be made to have the appropriate tests run. Other backfill is to be compacted and brought up to the level of the surrounding ground with some overfill to allow for settlement.

Backfill inside U-type abutments should be sloped and shaped to drain away from the bridge with drainable-type fill material.

In some cases, where the contract does not prohibit, it may be possible to complete designated Type II excavation without using shoring and cribs. If a contractor proposes to do this, it should be clearly understood that the portion of the lump sum shoring and crib amount shown on the plans for that bent or pier will not be paid.

Type I excavations are usually designated for dry or shallow, wet excavations. Type II excavations are usually designated for deeper wet excavations. Type I excavation does not automatically mean that shoring and cribs are not required.

Wet Excavations

Very often excavations will extend below groundwater levels. This requires the excavation to be dewatered before the foundation can be placed. The open or "glory hole" excavations and cofferdams are the two methods that may be employed for wet excavations.

Glory Holes

Environmental constraints and proper permitting procedures with the Department of Fish, Wildlife and Game, and/or the Water Quality Bureau, must be considered before this type of excavation can be utilized.

Glory holes in wet, granular material often result in a large excavation. The volume of water entering through the exposed area can exceed pumping capacity. The only alternative in this case is to construct a cofferdam that can be dewatered or sealed and dewatered.

The bottom of a wet excavation should be large enough so a sump can be provided and water can be channeled away from the foundation area. It is often found that a few inches of water will remain in a footing area. It is permissible to place concrete in up to 3 or 4 inches of still water, provided that certain precautions are taken. The footing area must be carefully examined for any "sand boils." These indicate water percolating up through the underlying soil. If concrete is placed over them, they will extend themselves up through the concrete and weaken the footing. Plastic sheeting can be placed under the concrete to seal these off, but care must be used. Concrete should be placed beginning at the point furthest from the sump and proceed toward it. It is advised to increase the cement content of the first load or two placed in the water. After the initial concrete is placed, all succeeding loads must be placed as close to full depth at one time as possible. Dewatering must continue until all concrete has taken its initial set. Depositing concrete in deep or flowing water using the open bucket method is prohibited under any conditions, even if contained with form work.

With respect to seal construction, water percolating up through the bottom of a wet excavation can also reduce or entirely destroy the bearing capacity of the soil. This particularly is a problem in dewatering unsealed cofferdams but can be encountered in deeper open excavations. Soundings should be taken before and after dewatering if this is expected to be a problem. Pumping a hole down and allowing it to fill several times can have an adverse effect on foundation materials and should not be permitted.

Once the footing has been placed and is set, the pump intakes should be raised as far as possible above the bottom of the footing. This will reduce the possibility of washing fine material out from under the footing and causing settlement.

Cofferdams
(209.03.3)

Cofferdams are used where water and soil conditions make an open excavation impractical, unsafe, or objectionable from an environmental standpoint. Cofferdams are usually some form of sheeting piling with bracing inside.

Cofferdams are a tool of the contractor, and the details are largely left to the contractor's choice. However, the contractor must submit drawings and design calculations for complicated excavations, and the proposed method before construction begins. These drawings must be reviewed, signed, and sealed by a registered professional engineer. The Engineering Project Manager is to comment on the drawings as necessary. Drawings are also to be submitted by the Construction Bureau for review and transmitted for DWFP or R.R., approval where required. The Construction Bureau should be notified if the dimensions are significantly changed or if the size and spacing of supports is reduced.

Written authorization from the Construction Bureau is required to leave any portion of a strut or other cofferdam member embedded in the permanent work or left within a stream channel.

Unsealed Cofferdams

In this type, the water is removed without sealing the bottom. One problem that often develops with this type of cofferdam is piping or bottom blow-in when the cofferdam is pumped. It is necessary to drive sheet piles well below the bottom of the footing excavation to prevent this. In loose, sandy soils, this may require the sheets to be driven below the footing a distance equal to twice the water depth above the bottom of the footing. If at the edge of a stream, a permit shall be obtained from the governing agency.

Rocks and boulders sometimes prevent the sheets to be driven a sufficient distance. In all cases involving spread footings, soundings must be taken before any pumping is done. Pumping should be halted immediately if any large boils of water and/or fines are seen.

Sealed Cofferdams

In this type of cofferdam, a concrete plug is placed in the bottom to seal it off. If no piling is used, the water pressure at the bottom is offset by the weight of the seal. The contractor may increase the plan seal thickness, but at no additional cost to the Department. If any alterations to the seal design are encountered, coordination with the Construction Bureau will be necessary.

The concrete in a seal must develop sufficient strength to resist the water pressure before a cofferdam is dewatered. Remember that strength development is slow in concrete cured in cold water. A backup system during seal placement is required by specification and may prevent a major problem during seal placement.

Spread Footings

(209.03.5)

Spread footings basically consist of a reinforced concrete pad to distribute the load of the structure over the foundation soil. The allowable load determines the footing size. The allowable load is the load per square foot that the soil is able to withstand without failure.

Shale encountered in Eastern Montana requires special treatment. In wet excavations, this shale becomes mud when exposed to air. It is necessary to remove the mud just before the concrete pour.

In some cases, a fill settlement period is required for spread footings in approach fills. In these cases, structure settlement check elevations must be maintained.

Spread footing inspection consists of logging material types in the excavation and performing soundings at the bottom of the excavation. In cofferdams or wet excavations, the material being removed from different elevations must be observed when evaluating adequacy of the foundation.

A sounding device with a 20-pound hammer is used to sound the bottom. Plans for this device are available from the Construction Bureau.

Footings should be excavated nearly to grade and should be in the condition expected during concrete placement. For example, if the footing is to be placed in the dry, then the area should be pumped and nearly dry when sounded.

Soundings are to be taken 0.3 feet to 0.4 feet above plan elevation to avoid disturbing the material at plan elevation.

If the condition of the footing changes significantly between the time approval is given and the time for concrete placement, new soundings are required for approval. An example of this condition would be a large amount of water at the bottom of the excavation after originally sounding in nearly dry conditions.

Normally, sounding should be taken in each corner of each footing. For large piers, retaining walls, abutments, and the like, soundings should be taken every 10 feet along the sides. Soundings should be done closer spacings when material varies, regardless of the size of the footing. Additional soundings are to be entered on Form BR-10.

Foundation materials for bridge footings can be approved in the field if all of the following conditions exist:

1. The materials found at base-of-footing elevation are substantially as indicated by the core logs.

2. The penetration of the sounding rod for the first series of ten blows does not exceed five inches.

3. The penetration of the last series of ten blows is not more than one inch.

4. The footing will be placed at plan elevation.

If all of these conditions apply, it is only necessary to not field approval on the completed Form BR-10A and send it to Construction by fax machine. If one or more conditions do not apply, call the information in to Construction as usual. (And call if anything is questionable.)

The following are general guidelines for completing Form BR-10:

1. Record a sufficient number of series to adequately represent the footing material. 8 to 10 series are normally sufficient for good footings.

2. Record the actual elevations where the soundings are taken.

3. Provide an accurate log of materials encountered.

4. Record the elevation where groundwater was encountered, the number and size of the pumps required to dewater the hole, the water depth when footings were sounded, and the planning method of placing concrete.

5. The Engineering Project Manager should indicate what action should be taken based on experience and actual field conditions. Detailed information and explanation are particularly important when a deviation from plan elevation is recommended.

Form BR-10 shall be sent to the Construction Bureau.

Placement of footing concrete is not to begin until approval has been given.

Test Piles

(559.03.1)

Test piles are almost always required where timber piles are required. A steel test pile is usually called for when designated as friction piles. Friction piles depend upon the lateral sides of the pile and the soil interaction after piles have set up.

Test pile information is used to set the length of service piles so sufficient load carrying capacity will be attained and extra pile length won't be used. Special measures must be taken in driving test piles. The area must be excavated to plan grade and any specified pre bore must be done. Pre bore will be defined in the plans and special provisions. The equipment used must be the same as will be used for service piles. Test piles must be driven in as continuous an operation as possible. Equipment breakdowns and short stops to cut off or fresh head the piles are the only excusable delays. Driving test piles is somewhat different than driving service piles. In general, they are driven to the cutoff elevation or as far as possible without damage to the pile. Driving should continue after practical refusal is first reached to assure that the pile has not encountered a thin, hard layer. If the calculated bearing is close to or less than required

on the plans when the butt of the pile is approaching cutoff elevation, sufficient length of the pile should be left to permit redriving after a setup period and to make a splice, if necessary.

Test piles are to be marked off in foot increments from the tip. The number of hammer blows per foot are counted and recorded along with other requested information on Form BR-21. Bearings in tons for each foot are to be calculated and entered on the form. Bearings need be calculated only to the nearest ton and need not be calculated for low blow counts when the hammer is not firing. The completed form to the Construction Bureau for setting subsequent pile lengths for production pile. This may be mailed, called in, or faxed in, depending on how urgent the need is for the engineer's order list. On rare occasions, the test pile lengths may be too short. In this case, remedial action will be coordinated with the Construction Bureau.

Timber Piles
(706)

Treated timber piles are always inspected at the source. Untreated timber piles are generally inspected at the source but must be inspected and accepted on the project. Steel pilings are accepted on the basis of certified mill test reports. Whether or not inspected at the source, all piling must be inspected on the project before use. Timber piles must be checked for proper tip and butt diameter and length. The Materials Bureau should be contacted if there is any question as to the quality of timber piles. Experience is necessary to properly apply rules used for grading timber piles. Steel piles must be checked for proper section and dimensions.

Timber piles are to be furnished with a minimum of two feet additional length, and steel bearing piles on an engineer's order list are to be furnished with one foot additional length, or as specially designated. This additional length is not measured for payment, but is the property of the Department. At times the contractor may require more length to fit his driving operation.

Any length in addition to that specified is not measured and remains the property of the contractor. Payment for furnishing includes all hauling, handling, and treatment up to the point the pile is ready to drive.

Drive Piles
(559.03.4)

Operation should be observed to ensure that the upward ram travel is at least equal to the length of the fall used to calculate rated energy. If not, operation should be suspended until repaired. All manufacturer's recommendations are to be followed precisely.

Alignment should be checked often during early stages of driving. It becomes practically impossible to pull a pile into alignment without damage after very much penetration. Although the specifications make no allowance for variation in pile position, some variation has to be allowed when driving piles

in water or rocky material. Changes in form dimensions or other corrective measures to compensate for deviations in pile position must be approved and will be at the contractor's expense.

Timber piles should be banded prior to driving, whether or not to point the piles is the contractor's decision, unless otherwise specified.

The Construction Bureau should be contacted whenever it is apparent that the piling cannot be driven to the required penetration without damage. Three possible alternatives may be specified: First, if structural conditions permit, the pile may be accepted at a lesser penetration. Second, hard driving may be required. Or third, the footing may be redesigned for a different type of pile, or to eliminate piling entirely. Foundations requiring hard driving or special hammers and equipment will be defined in the plans and special provisions. Generally, hard driving procedures will require some means other than the normal pile hammer.

The following checklist may be used to assist the inspection of pile driving:

- Footing excavated to plan grade.
- Reference set to check cutoff elevation.
- Piling has been inspected, all mill test reports and other material records on hand.
- Length, butt and tip diameters of each pile measured and recorded.
- Butt diameter measured 3 feet from cutoff length on order list.
- Piling not meeting length and diameter requirements is rejected.
- Pile layout checked immediately prior to driving.
- Pre bore holes checked for proper depth and diameter and backfill material qualified.
- Pile heads cut square.
- Sufficient cushion installed on drive cap.
- Hammers checked for proper equipment and fittings; hammer drip distance measured.
- When steel piles are to be spliced, welder is properly qualified.
- Welding inspected for conformance to plans.
- Pile position checked prior to driving.

- Pile templates provided when required by the special provisions.
- Piles checked for proper alignment and battering where required.
- Blow counts for each foot of penetration recorded for test piles.
- Pile condition and alignment checked frequently during initial driving, periodically thereafter.
- Penetration measured per ten blows periodically.
- Assistance requested whenever necessary.

Deck Construction

Steel Spans
(556)

Field Splice Grades
(556.03.13)(B)

The deflection at any point on a continuous girder is influenced by loads in other spans. Therefore, the entire line of a continuous girder must be erected before adjusting and tightening field splices. Where splice points are supported on temporary bents and held firmly at grade, this requirement does not apply.

Field splice grades must be calculated as the first step. This involves finding the plan top of deck or top of web elevation, the total dead load deflection, vertical curve offset, if any, and the dead load deflection due to the weight of the girder alone. The top of deck elevation can be calculated in the usual manner or interpolated from tenth-point elevations if given in the plans. Dead load defections are given for the tenth-points. For other points on simple spans, they can be estimated closely by using the deflection at the 0.5 tenth-point and the square of the distance from splice to bearing divided by the square of half the span length. Sometimes, rather than giving the dead load deflection for the girder alone, the plans will give the weight of the girder and total dead load weight. The deflection of the girder alone is directly proportional to these weights. An example of a typical field splice grade where the web is cut on a camber is shown at the end of the chapter, Example No. 1, on pages 8-25 and 8-26.

Note: Engineering calculations and field measurements associated with finish grades and deflections are often assigned to the prime contractor. When that is the case, your responsibility as inspector will be to check, or have checked, independent of construction activities, their engineer's notes for correctness, but not to do their work.

Rolled Girders and Straight Web Girders

The procedure for calculating grades and adjusting splices is essentially the same for this type of section. The exception is that "D" distances for this type girder include allowances for vertical curve offset and dead load deflection. Typical calculations are shown in Example No. 2, on page 8-27.

Deck Form and Top of Deck Grades

The actual profile of each girder must be determined once the splices have been graded and tightened. This is done by shooting the elevation of each tenth-point to the nearest 0.01 foot, the same as for prestress beams.

If at all possible, these elevations should be taken on a cloudy day, in the afternoon, when the temperature through the entire girder is practically even. A large temperature difference between top and bottom flanges, such as when the bottom is shaded while the top is in direct sunlight, causes the girder to deflect upward. This can cause a midspan sag in the deck slab if tenth-point elevations are taken at such a time.

The load condition of the girder must be known at the time the tenth-point elevations are shot so the girder deflection can be estimated. It's best to do this before forms are placed because the plans usually give the deflection for the girders alone. The deflections at other times can be estimated with reasonable accuracy by multiplying the dead load of concrete by the proportion of weight of the forms, etc., to the weight of concrete. Every effort must be made, however, to obtain all tenth-points prior to the beginning of slab form construction.

There are several ways to compute form grades.

"D" Depth Method

This is the preferred method of computing deck form and screed grades for steel girder bridges. Typical calculations are shown in Example No. 3, beginning on page 8-28.

Form Grade Point Elevation method

This method of establishing form grades is similar to that generally used for prestress beams. The cuts or fills from tenth-points to forms are calculated from grade elevations rather than "d" depths. Typical calculations are shown in Example No. 4, on pages 8-31 and 8-32.

Finishing Machine Grades

The longitudinal rails for the finishing machine are usually supported on the overhang, or in some cases, on the exterior girders. They are therefore subject to vertical movement resulting from dead load deflection. Proper allowance for this must be made in setting grades for the rails. The cambered appearance of edge forms will be visibly apparent on both simple spans and continuous structures before concrete placement.

In all cases, grades for finishing machine rails must correspond to the girder tenth-point elevations previously established. The preferred method is to use the girder tenth-points as benchmarks to set rail grades. It is not an acceptable practice to set these grades from benchmarks off the bridge unless sufficient girder tenth points are checked to ensure that tenth-point and rail elevations are in the correct relationship. It is also a good practice to check wing wall elevations and the centerline profile, if possible, before concrete placement.

Form Grade and Reinforcing Bar Clearance Check
(552.03.4 and .5)

The specifications require a trial run of the machine to check forms and the cover over the top reinforcing bars. The form grades can be checked by shooting elevations or from the machine during the trial run. The "d" depth method of calculating grades is advantageous for checking the machine. Excessive overhang deflection can be detected by positioning the roller or float over a tenth-point and measuring from the top of the beam. This distance should equal the "d" depth used for setting forms, etc. Incorrect interior bay form adjustments can be detected by measuring from the forms to the roller. This should equal the slab thickness "t."

Whether or not the discrepancy is in the machine or forms can be determined by measuring from the tenth-point on the girder adjacent to the rollers. If this checks with the "d" for that point, and if the distance from the top of beams to the roller checks with the "d" on the exterior girders, then the forms have to be in error.

The grade of the deck forms controls the position of the reinforcing steel. Obtaining the proper concrete cover over the top mat requires close adjustment of forms to the proper grade. The importance of maintaining adequate concrete cover over deck bars cannot be over-emphasized. Inadequate cover is a major factor in premature deterioration. Forms shall be adjusted to a tolerance of +0, -1/4 of the proper grade, exclusive of any allowance for form settlement.

Reinforcing bar cover can best be checked by attaching a filler equal to the plan cover to the bottom of the strike-off of the finishing machine. The strike-off is then operated over the entire deck area to check cover during the trial run. A tolerance of up to 1/4-inch more cover (from established requirement in plans) is allowable.

Forms can be checked by shooting elevations. This is best done by using offsets from tenth-points to establish grades. If an outside benchmark is used, sufficient checks on the bearing tenth-points should be taken to ensure that the reference elevation coincides with that used in taking tenth-point elevations. Use of an outside benchmark requires guessing a partial dead load deflection, which is not desirable. Typical calculations are shown in Examples 5, 6, and 7, beginning on page 8-33.

Grades - Prestressed Girder Spans
(553.03.15)

Procedures for calculating form grades, rail grades, etc., on prestress girder spans are essentially the same as for steel spans. There are some minor differences. Prestress girder structures are usually designed as simple spans. This means a particular span is not influenced by loads in other spans. Therefore, tenth-point elevations can be shot and computed on a span-by-span basis. There are no splices so it is not necessary to calculate grades, etc., for these.

ADP Calculation of Bridge Deck Grades

Deck elevations for most bridges can be calculated automatically by available computer programs. When running programs, the same care and checking as with manual computation is critical. The program will not work for curved girders or structures with non-standard super-elevation transitions. Grade elevations, as mentioned, may be furnished in such situations by the Construction Bureau.

Grades - Cast-In-Place Girders
(554)

Calculation of grade elevations for cast-in-place girder and slab girder structures is the same as for girder-type structures.

Dead load deflection must be taken into account in the calculation of grade elevation for forms on this type of structure. Dead load deflection is provided for by cambering the forms for the girder and deck slab. This camber must be reflected in the grade for the screed rail. The grade elevation for and screed rails is calculated by adding the amount of camber to the finished grade elevation. The forms, top of girder, and top of slab will retain this camber during placement of concrete, losing camber as the pour progresses.

In addition to camber for dead load deflection, allowance must be made for settlement of forms and bracing. A rule of thumb is that 1/16 of an inch consolidation will occur per joint in wood forms and bracing.

It is emphasized that except for form settlement, grade elevations for forms, screed rails, etc., on cast-in-place construction do not change until the forms, bracing, and shoring are removed at the end of the

specified period. Dead load deflection due to deck concrete and upward cambering tend to be self compensating.

Form Work

(552.03.4)

The use of wooden wedges behind the legs of overhang brackets to maintain position should be discouraged. Wooden wedges are subject to crushing and have caused serious problems in maintaining the proper grade for the screed machine during concrete placement. In all cases where the screed machine is supported on the overhang, spacing of the brackets must be such that there is no deflection in supporting members between brackets. Any deflection will be reflected in the deck slab surface.

Plywood use in the interior bays should be sound with ragged edges trimmed off and all pieces fitted tightly together. Holes in plywood form surfaces shall be plugged with cords or wooden plugs only. Metal patched are not permissible.

All corners and edge shall be filleted or chambered. The only exception is the point where the overhang contacts the outside of the exterior beam.

The joint between the overhang forms and the outside of prestress beams is a common problem area. Overhang forms must remain tight against the beam during concrete placement to prevent loss of mortar and resulting honeycomb.

The welding of form hangers to tension flanges on steel girders is not permitted. Welding of form hangers, screed supports, etc., to stress carrying reinforcing steel is also not permitted. Hangers may be welded to the outside leg of projecting stirrups on prestress girders.

The contractor may be requested to furnish details for approval of the form system. This should be done if the strength appears inadequate or if the system is unfamiliar. These details can be forwarded to the Construction Bureau if they appear to be unsatisfactory.

Forms and Falsework — Cast-In-Place Construction

Forms and falsework for cast-in-place flat slab and girder structures require special attention due to the loads they are required to support. They usually must support the entire superstructure. This support must be maintained throughout the specified cure period.

Substantial foundations are required for falsework. The two methods most often used are temporary piling and mudsills. Piling must be driven to sufficient bearing capacity to support the imposed loads.

Mudsills can be used only where soil conditions provide adequate bearing. The areas on which the mudsills are placed must be thoroughly compacted. Consideration must also be given to the effects of frost, rain, or other moisture on the bearing capacity of the soil. The structure can be severely damaged if the falsework settles during the curing period. Any questions as to the supporting capacity of falsework foundations should be resolved prior to erection. The contractor is responsible for providing an adequate false work design and construction.

Tell tales shall be provided on all cast-in-place falsework. These should be placed near adjustment points at midpoint of clear spans of main support beams. Tell takes should be monitored frequently for falsework failures.

The contractor should be required to submit falsework plans for review if there is any questions as to their adequacy. For major spans or bridge systems, the Department will require, by contract, that falsework plans and calculations be stamped and provided by the contractor's structural engineer.

Reinforcing Steel

(555)

The location of reinforcing steel within a slab is critical. Bars located below their plan location are not fully effective in carrying stress. Extensive premature deterioration can result if the bars are located too close to the surface.

The height of the bar supports (chairs) determine the location of the bar within the slab. Most of the upper bar supports are manufactured in 1/4 inch increments of height. Often the nominal height calculated from plan cover and slab thickness will be an odd 1/8 inch. This will be rounded off to the next lower 1/4 inch nominal height for determining the correct bar support height. Bar supports must be checked for height as soon as they arrive on the project. It should be remembered that there is a manufacturing tolerance of plus or minus 1/8 of an inch from the nominal height of bar supports. Supports with incorrect nominal height will not be acceptable.

Inspectors should periodically check bar size, spacing, tie intervals, support heights, and clearances to eliminate costly corrective work after all the bars are tied in place.

A final inspection is mandatory after all bars are in place. Concrete may not be placed until all reinforcing steel is inspected and approved. Grade checks, as previously discussed, must be completed.

Bars extending out of diaphragms and backwalls should be protected prior to concrete placement.

Bars for curbs and barriers usually extend out of the slab. Use of these bars as walkways or to support walk bridges or other equipment should not be permitted. Barrier bars must also be protected from curing compound and concrete splatter.

Drains, Guard Angles, and Expansion Devices
(552.03.13)

Grades for guard angles should be checked and compared to deck form grades. They should further be checked during the trial run of the screed machine. The slope of the guard angles may not be the same as the slope of the drum or float due to the dead load defection allowance in the screed rails and should be adjusted accordingly.

The pavement notch is provided by offsetting and widening the upper portion of the backwall on some structures. The forms for this are subject to rotation under the load of the concrete. This in turn can cause the guard angles to end up with the wrong slope or be below grade. It is essential that these forms be adequately braced to prevent form displacement. Kickers or backwall support work should be checked before concrete placement.

Construction joints consist of a pair of angles with anchors and clips for installation. It is necessary to set the proper joint opening according to the temperature of the girders at the time of installation. Once the joint is installed and securely attached to the girders, the short angles holding the two sides of the joint together should be loosened to permit each side to move independently. The bolts holding the joint together must be removed immediately after the last concrete has taken its initial set.

Finger joints are usually used where large movement is expected. It is important to adjust this type of joint so that the ends of the fingers do not extend above the surface. This joint requires considerable time and care during setting because of the very heavy sections used. Support hardware shown on the plans is provided for adjusting the joint system and is critical to success.

Elastomeric joints are usually installed on a shelf formed in the deck slab. It is very important that the bottom of the shelf be smooth and at the proper depth below the surface. The deck slab adjacent to the shelf must be straight-edged and ground to meet surface tolerance, if necessary. The shelf must then be built up or ground down to the proper depth for the seal. Air holes or other depressions must be filled with an epoxy grout. Seal manufacturers provide detailed installation procedures. These must be followed exactly. A copy should accompany the shop drawings for a particular joint.

Compression seals are frequently being used for rehabilitation work, or at locations where movements are relatively small and are designed to stay compressed with the formed joint opening. Consult shop drawings for installation.

Inspectors must ensure that all drains constructed will function as intended. Particular attention must be given to the drain's elevation with respect to the surrounding gutterline.

Deck Finishing Machines

(552.03.12)(E)

Finishing machines are supported by four adjustable legs. Raising or lowering the two leading legs or the two trailing legs will change the slope of the drum or float without changing the deck slab thickness. Raising or lowering all four legs will change the deck slab thickness. Raising or lowering two legs on one side will taper the thickness from one side to the other.

The framework of the machine can be adjusted to provide for crown.

The rails that the machine ride on can be adjusted to provide for the proper cross section.

Check list for finishing machine inspection prior to concrete placement:

- Rails set to proper cross section and alignment; clean and free of concrete, and do not sag under weight of machine.
- Roller or float operates freely and is clean; roller does not vibrate excessively during operation.
- Power units start easily and are in good condition.
- Adjusting bolts for rails are locked in position.
- Adjusting bolts and pins in framework are locked in position.
- Vibrator on float type machine operating properly.
- Augers in good condition and properly set.
- Leading and trailing edge of float or roller checked for correct slope.
- Pan float is clean and free of build-ups of concrete.

Things to look for during concrete placement:

- Voids in the surface — May be caused by the trailing end of the drum being too high.
- Ridge or groove in surface — May be caused by the trailing end of the drum being too low.
- Roll of concrete in front of drum — Indicates proper setting and operation.
- Excess concrete in front of augers — Too much concrete in front of the augers can pull the strike-off down. Excess material should be raked away.
- Tearing in surface or insufficient mortar for finishing — May be caused by improper speed of drum rotation.
- Adding concrete in front of single drum type machine — Acceptable practice if done occasionally to fill in low spots. However, this type of machine cuts only in one direction. When concrete is added it must be on the cutting pass. The drum rotates up and out of the concrete on cutting passes.

- Concrete left on the sides of the deck after each pass of the drum — This is a normal occurrence. However, because this material consists mostly of fines, it should never be used to fill the curb area. This material may be distributed ahead of the screed or removed and wasted.
- Changing the screed height to match guard angles — Must be made gradually over a sufficient distance to maintain surface smoothness. Also, adjustments must be made at both the leading and trailing points.
- Framework of the machine — Should be checked periodically to ensure that the framework remains parallel to the skew or perpendicular to the centerline, depending on the particular deck.
- Excessive vibration — Observe the machine for excessive vibration. This can cause longitudinal ridges in the surface. If such ridges are observed, transverse hand floating may correct the affected area.
- Condition of screed rails — Should be observed periodically to ensure they are free from unusual deflection, build-ups of concrete, electric cords, or anything else that could adversely affect the movement of the screed.
- Extra load on machine — During operation, no additional weight should be put on the machine. Extra load can cause deviations in the surface.

Skewed and Complex Bridges

Conditions of extreme skew, horizontal alignment transitions, and extreme vertical curvature cause complications in bridge deck finishing. The effects of these factors, and measures to compensate for them are discussed below.

Skew

Placing the finishing machine at right angles on a skew bridge results in each end being located at points with different dead load deflections. In addition, each intermediate beam point between the ends has a different deflection. The deflections change as the machine moves along the deck. For this reason, the position of the strike-off relative to the beams and forms changes constantly. If the skew is less than 15 degrees, the concrete strike off may be perpendicular to the beams.

By placing the concrete and operating the finishing machine parallel to the skew, the beams will be loaded equally. The ends of the finishing machine and all points in between are located over points of equal deflection. For this reason, the position of the strike-off relative to deck forms remains constant at all times.

Horizontal Alignment Transitions

Another problem occurs when the bridge is located on a spiral or run-off section. A "broken-back" may develop at some point between super-elevation and normal crown under usual run-off procedures. Deck finishing becomes complicated when that point falls on the deck. This situation requires adjustment of the transverse carriage rails on the finishing machine. The adjustment must be made in small increments as the machine progresses longitudinally along the deck. The run-off requirements and points of rotation for the superelevation transition are provided on the general layout. This requirement may vary depending on the service level of the roadway.

Run-off adjustment may be made in two ways. One way is to adjust three or four bolts on the machine at the crown adjustment points incorporated in the framework. Adjusting to a "broken-back" section is relatively easy if one of these points can be located over the point where the section breaks.

If crown adjustment is not possible, the individual rail supports will have to be adjusted. The adjustment of each bolt will vary from zero near the curb lines to the full amount at the break point. The increments must be small enough to prevent out-of-tolerance steps in the surface.

The combination of a bridge skewed in excess of fifteen degrees and located in a transition can create an extremely complicated situation even where a straight line section at right angles is maintained.

Sections along radial lines will be straight, however, sections on the skew may be broken. The magnitude of the break will depend on the degree of skew, amount of super-elevation, length of spiral, and run-off. The easiest way to determine if there is a problem is to plot several skew sections on a large vertical scale. The transverse machine rails will have to be adjusted as described previously if the plotted sections show a significant deviation from a straight line. In this case, individual bolt adjustment will probably be necessary.

Extreme Vertical Curvature

A large grade change with a short vertical curve can also create a problem on bridges skewed more than fifteen degrees. Sections at right angles will be straight or normally crowned. Sections on the skew may be parabolic due to the vertical curve. The shape of the section changes as the shape of the vertical curve changes. Adjustment to the finishing machine will be necessary where the shape changes significantly from one end of the deck to the other. It will be necessary to make approximations in order to limit adjustments to the point where it is still feasible to place the deck.

The first step on complicated bridge decks is to plot sections parallel to the axis of the finishing machine at several locations along the length of the deck. These should be plotted vertically on a large scale. There will be no problem if the shape of the sections does not change significantly. Elevations may be obtained for these sections from the Bridge Bureau.

The following procedure should be followed to ensure that the contractor has made all the proper adjustments.

1. The machine is set to the proper section at a guard angle, expansion joint, or bulkhead.
2. The machine is moved to an intermediate point and adjusted to conform to the deck at that point keeping track of the amount of adjustment.
3. The amount of adjustment is pro-rated back to the beginning point and incremental adjustments are calculated for points in between.
4. The points and adjustment increments are marked on the curb forms.
5. This process is repeated down the length of the affected deck section.
6. Trial runs are made using the marked adjustments and checking depth and rebar cover.

The process of adjusting tenth points before placement is time consuming and only minor adjustments should be made during the pour. During hot weather, it is a good practice to use a retardant admixture. In most cases, transverse construction joints to reduce pour lengths will be approved by the Construction Bureau upon request. Operation of the finishing machine at right angles on skews exceeding fifteen degrees will be considered only for extremely difficult situations. A bridge on a forty-five degree skew with a spiral and sharp vertical curve is an example of an extreme condition.

For continuous steel girder structures, a placement sequence diagram is provided on the plans, and locates transverse construction joints.

Skew Bridge with Normal Crown

The adjustment of the transverse screed carriage rails for normal crown on the skew must be done somewhat differently than for a right angle structure. The reason is that the axis of the screed carriage wheels is skewed to the centerline of the roadway. Therefore, the carriage wheels do not cross the break point together.

The simplest way to adjust the carriage rails in this situation is to use a guard angle or a bulkhead that is set closely to grade. The rails are adjusted so the rollers or float will follow the grade. The section over the crown will require trial and error adjustment. It will not be possible to exactly match the sharp break in a normal crown. It can, however, be approximated reasonably close. It is necessary to use the leading edge of the rollers or float to adjust the front rail and the trailing edge to adjust the back rail.

Concrete Placement
(551) and (552)

Pre-Pour Conference

The practice of holding a meeting with the contractor and concrete supplier prior to placing the first deck slab is strongly encouraged. The following is a partial listing of the items to be discussed.

1. Pour rates and delivery times.
2. Number of personnel planned and needed to meet the pour rate and to place and finish the concrete.
3. Aggregate and cement required to be on hand.
4. Communication between plant and field.
5. Provisions for contingencies. (extra trucks, vibrators, pumps, generators, etc.)
6. Procedures for constructing bulkheads, protection from rain, etc.
7. Placing, finishing, and curing procedures.

Placement of concrete must not be allowed until any deficiencies revealed during the meeting have been resolved.

Air Content
(551.03.2)

Deck concrete must contain sufficient air to be durable. Therefore, air content must be continuously monitored during deck placement with the standard pressure test for control purposes.

Erratic air content may be caused by a variety of factors. A partial listing of causes and corrective actions follows.

1. Variations in mixer efficiency can affect the amount of air obtained from a given dosage of air agent. Air test results on different trucks may indicate the need to vary the dosage for individual trucks. Worn out mixers may not be capable of entraining the specified air.
2. Mixer speed sometimes can affect the amount of air entrained for a given dosage. Generally, the higher the speed, the higher the air content.
3. Slump greatly affects air content. The slump should be adjusted to the desired consistency for placing before taking an air test. Adjusting air agent dosage on the basis of tests on concrete with varying slump can produce erratic results.

4. There should be a generally straight line relationship between air content and air agent dosage. Large increases in air agent without corresponding increases in air content indicate something is wrong. Caution should be exercised if it becomes necessary to increase dosage beyond two to three times that normally recommended by the manufacturer.

5. Low air content can be corrected at the job site by adding air agent. This should be mixed with a small quantity of water before adding it to the mixer. The mixer should be rotated at least twenty revolutions at mixing speed after adding.

Mix Design Changes
(551.03.2)

Occasionally, concrete produced from approved mix designs is found to have poor workability and/ or finishing properties. Any changes to correct such a situation are to be requested from the lab.

Placing Operations
(552.03.5)

Forms and rebar must be wet down immediately prior to placing concrete. Under no circumstances is fresh concrete ahead of the finishing machine to be sprayed with water.

When pumps are used for deck slab concrete, all samples are to be taken from the discharge end.

The concrete is to be placed as close as possible to its final position. The heading of placement should be parallel to the finishing machine, and be maintained approximately five to ten feet ahead of the finishing machine. The rate of production and placing must be adjusted to the rate of finishing.

Continuous Span Sequence Pours
(552.03.5)(E)

The plans for continuous steel girder spans usually specify that the deck slab be placed in a definite sequence. This is done to control dead load deflections. It is very important that the sequences be constructed exactly as shown. Unanticipated girder stresses and deflections can result if they are not followed.

Sequence pours require transverse bulkheads. These must be straight and adequately braced. The top of the bulkhead is to be cut to grade.

Finishing Operations
(552.03.12)

Because surface durability is reduced by excessive manipulation, hand finishing should be kept to a minimum.

Water is not to be added unless the inspector deems it necessary to aid in finishing. When approved, water should be added in a fog spray. It is never permissible to add water as a stream from a hose or by throwing it on with a brush. Excessive addition of water to the surface constitutes retempering and may be grounds for rejection of the affected portion of the deck.

Hand work is necessary next to curbs. The finishers must check this area transversely and longitudinally with a straightedge to ensure that it will drain properly. Mortar left by the finishing machine must be discarded or moved ahead. It is not to be placed in the curb area.

The entire surface is to be hand floated prior to texturing. The major concern with texturing is timing. Texturing done too soon will result in the grooves closing. Texturing done too late will result in tearing the surface. The areas within one foot of the curb are to be left smooth.

Curing and Protection
(551.03.6)

As soon as the water sheen disappears from the surface, curing material should be applied. This is very important because shrinkage cracking will develop if the surface dries out before the concrete sets. For this reason, an early application is preferred over a late application. In addition the inspector must ensure that a complete, uniform coverage is applied at the proper application rate.

Cold Weather Protection for Deck Slab Concrete
(552.03.9)

Materials for housing and heating must be on-hand before any cold weather deck pour is allowed. The contractor must also make arrangements to house and heat on weekends and holidays during the cure period in the event of sudden weather changes.

Emergency Situations

Unsuitable Weather
(552.03.12 E7) and (501.03.10)

Inspectors have no authority to prevent the contractor from starting a deck pour because of a weather forecast. Inspectors should however, offer opinions and make it clear that the contractor is responsible for repair of any potential damages.

Contractors should always have a sufficient supply of plastic sheeting on hand to cover the deck in the case of sudden rain or hail storms. Concrete placement should be halted as soon as rain appears imminent.

Under no circumstances should the concrete be vibrated, worked by the finishing machine, floated, or textured during the rain. This will only work water into the concrete and weaken it.

Inspectors are not to direct the contractor as to what remedial actions should be taken. It is the contractor's responsibility to obtain satisfactory results. When placement has been jeopardized by hail or rain, the inspector should remain on the site to document the events until operations are complete.

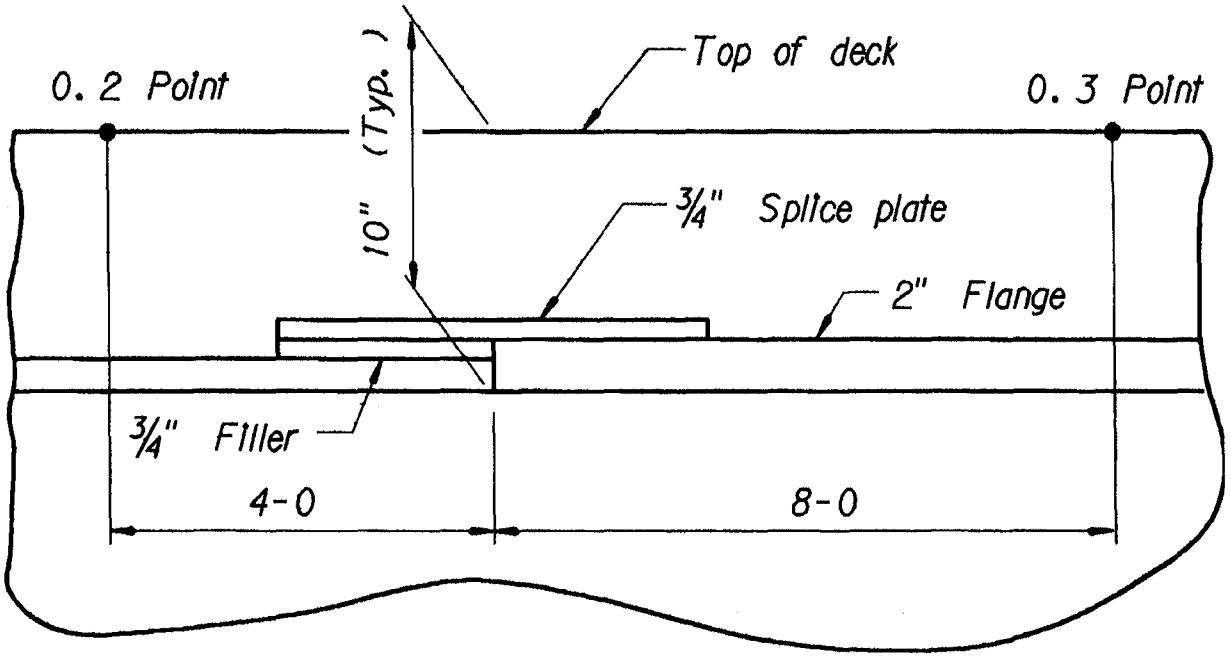
Although cold joints are to be avoided when possible, construction joints are far preferable to placing concrete in the rain, or other unsuitable conditions that will lead to detrimental quality of the deck.

Small, routine repairs may be approved in the field. More complex and extensive corrective work will require that the contractor submit a written proposal. This must be approved in writing prior to the work. A guarantee of the repair may also be required.

Equipment Breakdowns

As a general rule, the pour should be stopped and a construction joint installed anytime it becomes impossible to secure satisfactory results.

EXAMPLE NO. 1: FIELD SPLICE GRADE CALCULATIONS (WEB CUT ON A CAMBER)



Given in Plans:

Finished grade at 0.2	=	5212.10
Finished grade at 0.3	=	5212.13
D.L. Deflection at 0.5	=	1" Girder and diaphragms
Total D.L. Deflection at 0.5	=	3"

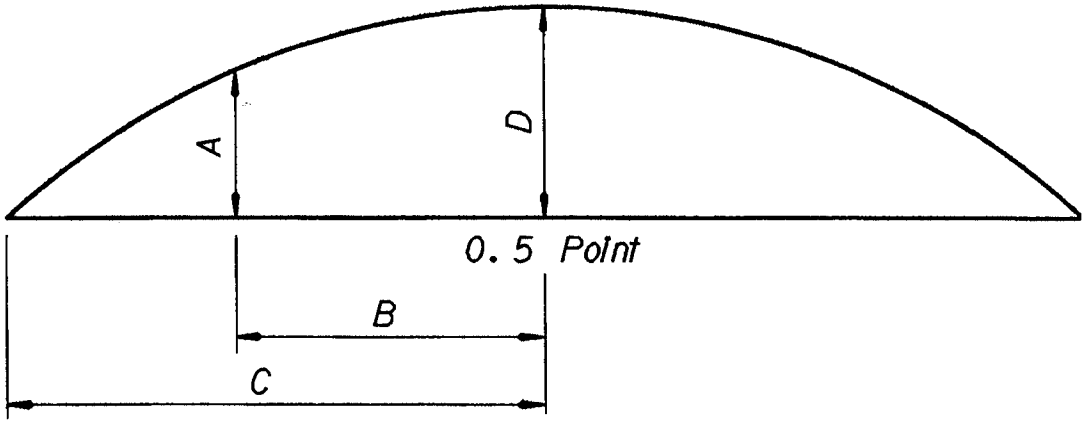
By Interpolation:

Finished grade at splice $5212.10 + \left(\frac{0.03 \times 4}{12} \right)^{*} =$ 5212.11

* 0.03 ft. = difference in tenth-point elevations from 0.2 pt. to 0.3 pt.

$\frac{4 \text{ ft.}}{12 \text{ ft.}}$ = linear proportion from 0.2 pt. to 0.3 pt.

Calculated D.L. Deflection at Splice — Simple Spans



$$A = D - D\,\frac{B^2}{C^2}$$

Note: This calculation example is not applicable to continuous spans.

A = Deflection at splice

B = Distance from splice to midspan

C = 1/2 span length

From Plans:

B = 32'

C = 60'

D Girder alone = 1" = 0.0833'

D Total = 3" = 0.2500'

$$A \text{ Girder alone} = 0.0833 - 0.0833 \times \frac{32^2}{60^2} = 0.0596'$$

$$A \text{ Total Defl.} = 0.2500 - 0.2500 \times \frac{32^2}{60^2} = 0.179'$$

Note: D.L. Deflection for splices on *continuous spans* has to be estimated by interpolating from adjacent tenth points.

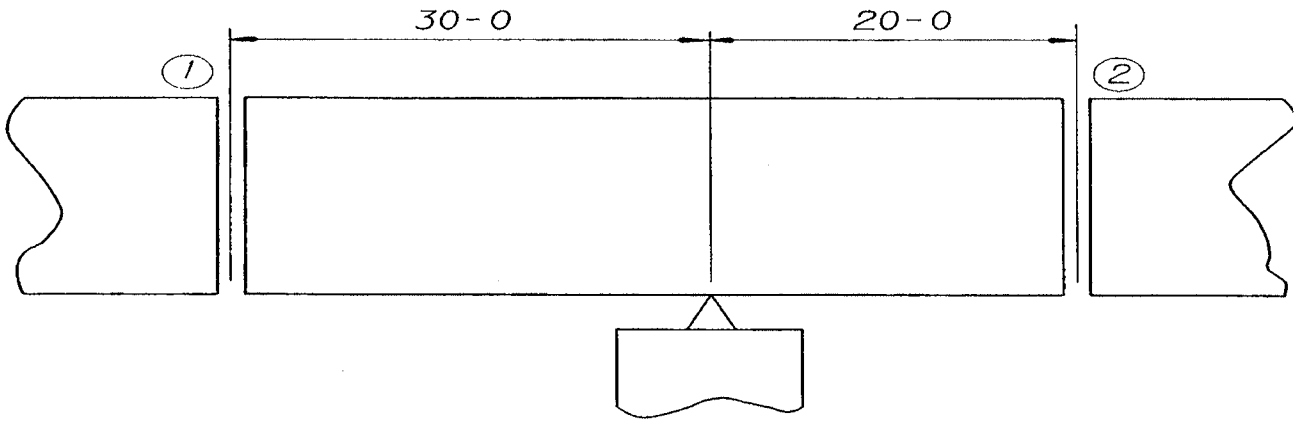
Grade Calculation for Top Splice

Finished Grade at Top Deck	=	5212.11
- 10"		- 0.8333
Finished Grade at Top of Web	=	~~5211.2767~~
+ Total D.L. Deflection		0.1789
		~~5211.4556~~
- Deflection, Girder Alone		- 0.0596
Plan Elevation, Top Web, Girder Erected	=	~~5211.3960~~
+ Flange Plate, 2"	=	+ 0.1667
+ Splice Plate, 3/4"	=	+ 0.0625
Plan Top Splice Grade	=	~~5211.6252~~

Adjustment of Splices -- Continuous Girders

Several factors must be considered in adjusting the grade at a field splice. The elevation at the splice is controlled by the position of the girder section bearing on a pier or bent. This girder section is in effect a seesaw. When one end is raised, the other drops. For this reason, it may not be possible to adjust the splices at each end to plan grade. If the grade at one end is above or below plan when the other is on, it will be necessary to balance the section. An example of this process follows.

EXAMPLE NO. 2: ADJUSTMENT OF SPLICES -- CONTINUOUS GIRDERS



Plan Grade at (1) = 5126.12
Plan Grade at (2) = 5126.30
} Difference = 0.18'

(1) set at plan elevation 5126.12

Elevation from shot at (2) 5126.36

Plan elevation at (2) 5126.30

(2) is 0.06 High

Raising (1) will lower (2)

Calculate amount of rise = $0.06 \times \frac{30^*}{50} = 0.036$

(2) will lower $0.06 \times \frac{20^*}{50} = 0.024$

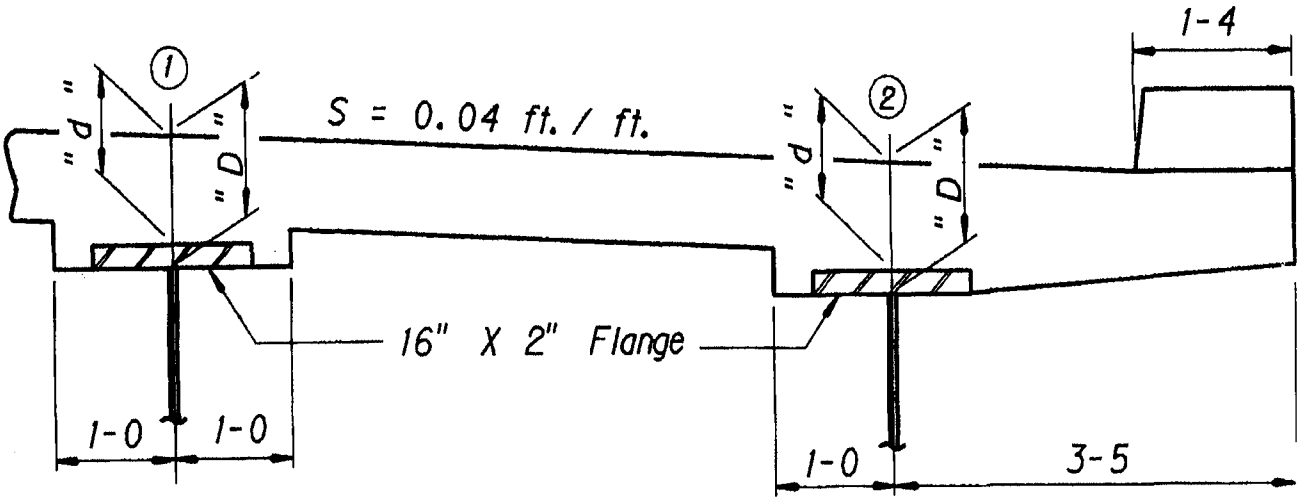
* Proportioning over supported section for 50' difference in length.

New grade at (1) = 5126.12 + 0.036 = 5126.156
New grade at (2) = 5126.36 - 0.024 = 5126.336
} Difference = 0.18'

The girder section is now balanced, with each end 0.036' above plan grade. The correction in this example is large, generally exceeding those actually found in the field.

EXAMPLE NO. 3: "D" DEPTH METHOD

Cambered Web



Total D.L. Deflection = 1 7/8"
D.L. Deflection of Steel = 3/8"
D.L. Deflection of Concrete = 1 1/2"

Plan Grade at (1) = 3944.16

Plan Grade at (2) = 3942.80

Plan top girder as erected at (1) = 3944.16 - 0.6667 (10" - 2") + 0.1250 Concrete D.L. = 3943.6183

Plan top girder as erected at (2) = 3942.80 - 0.6667 (10" - 2") + 0.1250 Concrete D.L. = 3942.2583

Shot at (1) = 43.64

Shot at (2) = 42.22

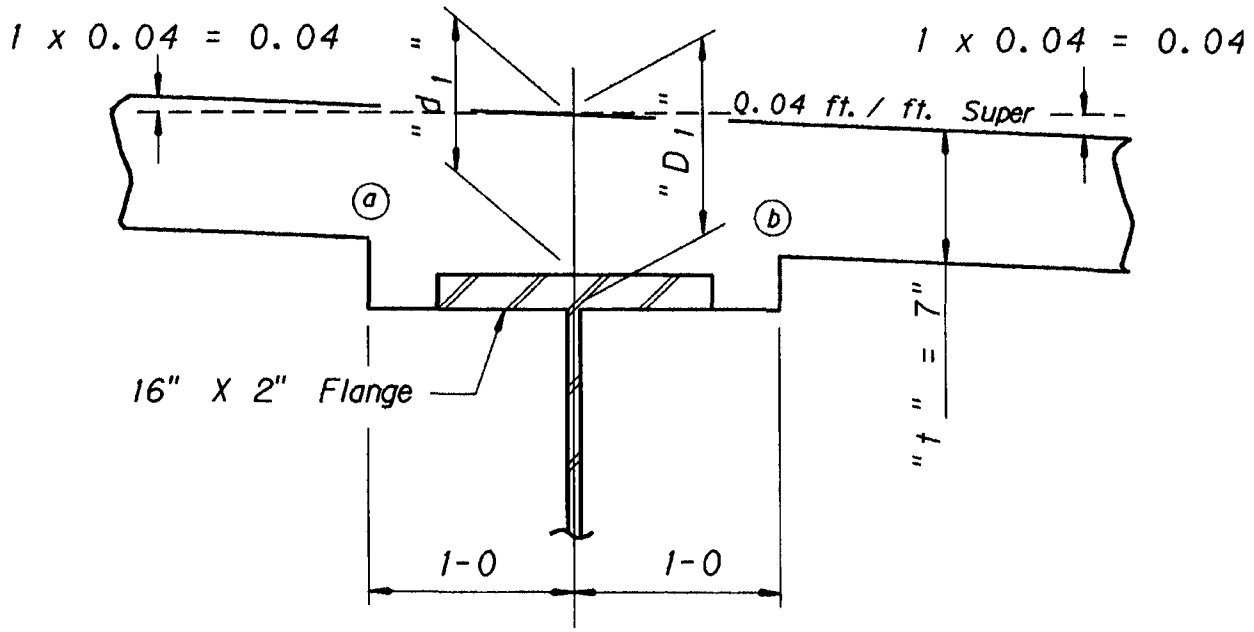
43.64 - 43.6183 = 0.0217 Girder at (1) is high

So new "D_1" = 0.8333 - 0.0217 = 0.8116'

42.2583 - 43.22 = 0.0383 Girder at (2) is low

So new "D_2" = 0.8333 + 0.0383 = 0.8716'

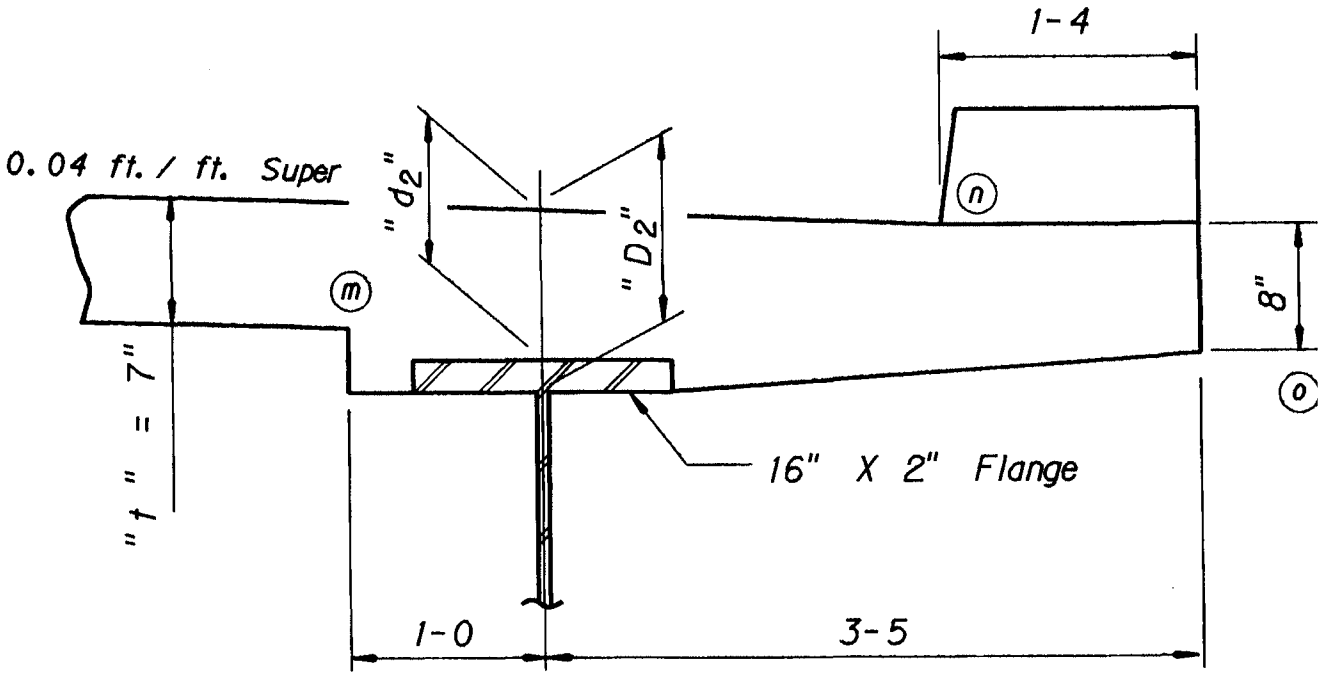
Deck Form Grades, Interior Girders



"d_1" = D_1 - 0.1667 = 0.8116 - 0.1667 = 0.6449

Top deck at (a)	0.6449 + (1.00 x 0.04)	=	0.6849
less t, 7"		=	- 0.5833
Fill to (a)		=	0.1016 = 1 1/4"
Top deck at (b)	0.6449 - (1.00 x 0.04)	=	0.6049
less t, 7"		=	- 0.5833
Fill to (b)		=	0.0216 = 1/4"

Deck Form Grades, Exterior Girders



t = 7" = 0.5833'

D_2 = 0.8716' (2" flange)

d_2 = 0.8716 - 0.1667 = 0.7049' "reference point"

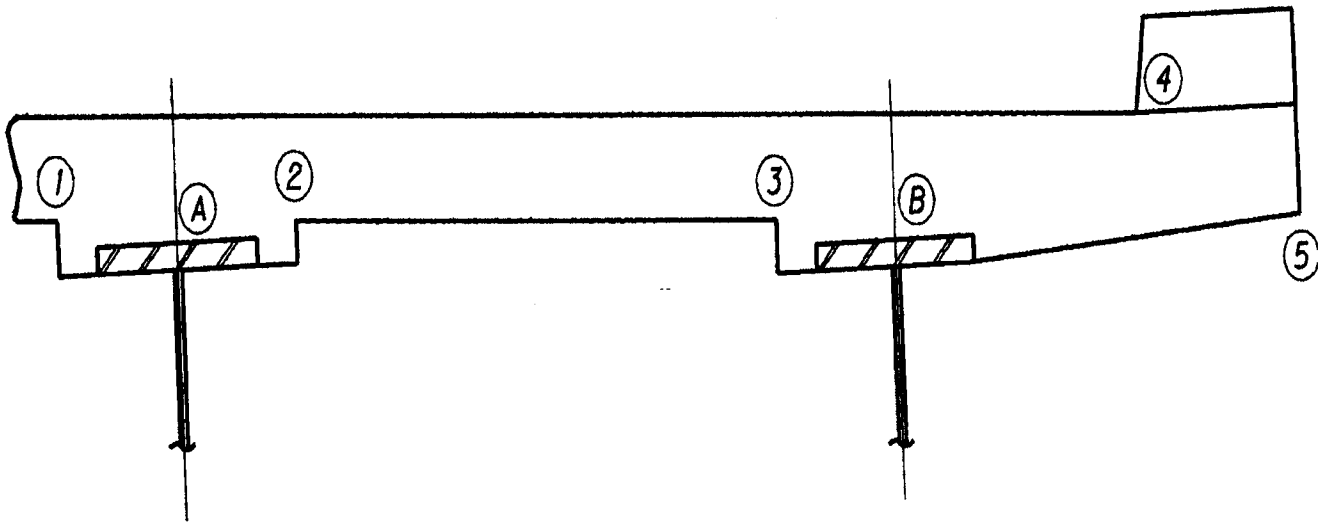
(m) = 0.7049 + 1.00 x 0.04 - 0.5833 = 0.1616' or fill 1 15/16"

(n) = 0.7049 - 0.04 x 2.0833 = 0.6216 or fill 7 7/16"

(o) = (n) - 8" = 0.6216 - 0.6667 = 0.451 or cut 9/16"

Note: Curb or edge of slab may not be as shown above. See bridge plans.

EXAMPLE NO. 4: FORM GRADE POINT ELEVATION METHOD



Total Deflection = 2.5"
Structural Steel Deflection = 0.5"
Concrete D.L. Deflection = 2.0"

Calc. Finish Grade Elev.		+ Concrete D.L. Deflection	Form Grade
(1)	2241.6650	0.1667	41.8317
(2)	2241.6250	0.1667	41.7917
(3)	2241.3950	0.1667	41.5617
(4)	2242.0842	0.1667	42.2509
(5)	2241.3342	0.1667	41.5009

Shot at (A) Elevation 2241.66

Shot at (B) Elevation 2241.43

From Girder (A)

Fill 0.1717' or 2 1/16" to (1)

Fill 0.1317' or 1 9/16" to (2)

From Girder B

Fill 0.1317' or 1 9/16" to (3)

Fill 0.8209' or 9 7/8" to (4)

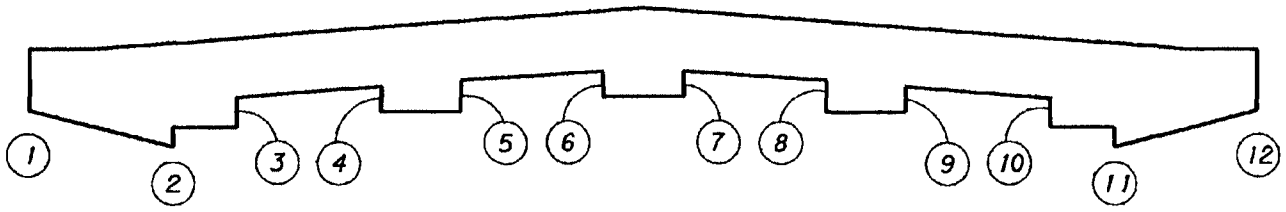
Fill 0.0709' or 7/8" to (5)

Considerable calculation time can be saved by this method if it is possible to use the ADP Bridge Elevation Program to compute grades. The Bridge Elevation Program cannot be used on curved girder bridges, and where nonstandard superelevation transitions and run-offs are used.

After cuts and fills for forms have been calculated, they should be listed in understandable form, along with a sketch. This information should be given to the contractor for use in forming the deck. A copy should be retained for inspection purposes. Following is an example of a list of forming information.

Deck Form Grades

Span No. 1 E.B.



Ahead-On-Line

Beam Tenth Point	Deck Form Points											
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
0 ℄ *Brg. Bent 1*	F 3/4	C 1/2	F 1 1/4	F 7/8	F 1 1/8	F 1 3/8	F 1 1/4	F 1	F 1 1/8	C 3/4	C 3/8	F 5/8
0.1	F 1/2	C 3/8	F 1 1/8	F 3/4	F 1	F 1 1/8	F 1 1/8	F 1	F 3/4	F 1	C 1/2	F 1/2
0.2				Continue for rest of tenth points								
0.3												

Finishing Machine Grades

The longitudinal rails for the finishing machine are usually supported on the overhang, or in some cases on the exterior girders. They are, therefore, subject to vertical movement from dead load deflection. Proper allowance for this must be made in setting grades for the rails.

In all cases, grades for finishing machine rails must correspond to the girder tenth-point elevations previously established. The preferred method is to use the girder tenth-points as bench marks to set rail grades. It is not an acceptable practice to set these grades from benchmarks off the bridge unless sufficient girder tenth-points are checked to ensure that tenth-point and rail elevations are in the correct relationship.

EXAMPLE NO. 5: SETTING GRADES FOR RAILS

The contractor proposes to set his screed rails 1.00 ft. above the top of the curb.

Use "d" depth offset from Example No. 3.

Offset to gutter line = n	=	F 0.6216'
+ Curb height	=	+ 1.0000
+ Offset to rail	=	+ 1.0000
Total offset, tenth point to rail	=	2.6216'
Rod reading on tenth point	=	9.50
- Offset to rail	=	- 2.62
Grade Rod for rail	=	6.88

An H.I. is not necessary for setting grades by this method. The H.I. should be established, however, as a check. The H.I. should be established from a tenth point on the girder end or over a bearing point. The other non-deflecting points on the bridge should be checked.

This elevation should agree with the elevation established when the tenth-point elevations were shot. In addition, a check against an outside bench mark should also be made.

This same method can be used to check form grades as follows.

EXAMPLE NO. 6: FORM GRADE CALCULATIONS

Use offsets from Example No. 3

Rod reading at tenth point	=	9.50
Offset for (m)	=	- 0.1616
Grade Rod for (m)	=	9.34
Tenth point rod	=	9.50
Offset for (o)	=	+ .0451
Grade Rod for (o)	=	9.55

Following is an example of setting rail grades from an outside bench mark.

EXAMPLE NO. 7: SETTING RAIL GRADES FROM AN OUTSIDE BENCH MARK

Contractor proposes to set rail 1.00 above top of curb.

Same conditions as shown on Example No. 3

Forms and re-bar estimated to be 30% of Concrete D.L. of 1 1/2"

0.70 x 1.5 = 1.05" D.L. remaining	=	0.0875'
Plan grade elevation at (2)	=	3942.80
less super 2.0833 x 0.04	=	- 0.0833
gutter line grade	=	42.7167
+ curb 1.0000	=	+ 1.0000
+ offset to rail	=	+ 1.0000
+ remaining D.L. Deflection	=	+ 0.0875
Top rail elevation	=	44.8042
B.M. elevation	=	41.58
+ B.S.	=	+ 11.10
H.I.	=	52.68
less Rail Elevation	=	- 45.80
Grade Rod	=	7.88

The main objection to this method is that it requires guessing the deflection due to forms, rebar, etc. If the guess is not correct, the forms will not check out during the trial run.

Chapter Nine

Miscellaneous Construction

Curbs and Gutters

(609)

General

Curbs help define the limits of the traveled roadway, contain and direct surface run-off to catch basins, ditches or inlets and help prevent the encroachment of vehicles beyond the roadway section.

Prior to construction, the inspector should make a field check to ensure that the proposed curb alignment and locations are clearly marked out. The inspector should give special attention to ensure proper horizontal and vertical alignment. If improper construction, such as rough or irregular alignment occurs, the curb should be subject to rejection and reconstruction.

Records should show date forms were ready, dates concrete was placed, where concrete was placed, inspector and major work inspected, weather conditions, quantities placed with each shift, major corrective action taken (if any) and records of other items as they occur. For instance, aggregate and cement test results should be on file and cylinder test results maintained.

Concrete Curbs

(609.03.2)

Foundation and Preparation of Forms

The plans usually require that the concrete be placed on a well-compacted crushed base course. Prior to placement of the crushed base, the existing soil must be brought to proper grade and compacted. Be sure that any soft, muddy spots are removed and replaced with stable, well-compacted material.

Inadequate or non-uniform compaction will result in curb settlement which in turn creates a drainage problems, cracked curbs and expensive maintenance.

Check to see that forms are set to proper line and grade by measuring from the offset stakes and sighting along the top of the forms. Badly dented or damaged forms should not be used. Forms must be adequately braced to resist the outward pressures that develop in placement of the concrete. All forms shall be mortar-tight.

Forms should be oiled in order to prevent the concrete from sticking to the face of the form. Excessive oiling will discolor the concrete.

Inspect the expansion joints, dowels, tie bars and reinforcement for proper location, size, and lap lengths. Be sure the steel is firmly in place and the proper number of ties have been made.

Concrete curb and curb and gutter may be constructed by use of an approved slip-form machine. Construction requirements will be the same as those required for the stationary form method, except that concrete slump may be reduced as necessary.

Placing Concrete

An inspector is needed at the point of batching to ensure that the correct portions of cement, fine aggregate, coarse aggregate and water are being furnished. Be sure the specifications are closely followed on recommended mixing times and maximum allowable elapsed time between mixing and placing.

Immediately before concrete is placed in the forms, the granular material on which the concrete will be placed should be thoroughly dampened, but do not let concrete be deposited in puddles of water. During hot weather, the aggregates and forms may require cooling by prewetting to avoid excessive loss of moisture.

The concrete should be placed in the forms in its final position with a minimum of shifting or manipulation of the mixture. The material should be vibrated only to form a dense well-compacted mass.

Vibrating along the edge of the form will help to eliminate voids and unsightly rock pockets but over-vibrating will work the larger rocks to the bottom and the fine material to the surface. Each manipulation of the surface tends to bring up fines, which if accumulated in excess, can later cause surface defects. The contractor should insert and remove the vibrator quickly. The vibrator should not be dragged through the concrete, nor should it be used to move concrete.

Finishing Concrete

On many projects, the contractor will utilize a curb finishing machine. Immediately after the concrete has been deposited, the machine travels along the forms and shapes the concrete into the specified curb design. The concrete is also vibrated at the same time.

The curb should be carefully inspected to be sure that the correct concrete curb shape is being produced. The speed of the machine must be carefully controlled or the desired results will not be obtained and more handwork will be necessary.

If the curb machine works correctly, little handwork is required other than floating and edging. The curb should be floated with a wood float just enough to bring the fines to the surface and to remove any irregularities. After floating and just prior to applying the curing compound, the surface of the curb should be brushed lightly to obtain a uniformly textured surface.

On curb returns and laydowns, the curb machine cannot be used and the finishing must be accomplished by hand methods.

When the curb must be finished by hand, care must be taken so that the desired shape is obtained, the flow line of the gutter is in the proper location, and has the correct depth. The surface of the gutter should be checked closely with a ten-foot straightedge so that any irregularities can be corrected at the start of the finishing.

At the completion of the floating operation, there may be free water on the concrete surface that has worked up during the settlement and consolidation of the rock. Delay further finishing until this water has evaporated and do not permit sprinkling of sand and cement mixtures on the surface to absorb this excess water.

Edging work can begin as soon as the water has nearly left the surface. An edging trowel produces the rounded or beveled edge at the top of the vertical faces. Edging helps prevent spalling and chipping and also provides a pleasing appearance. Contraction joints can be scored as required at this time also.

Forms should be removed after the concrete has taken its initial set. Minor defects in the surface shall be repaired at this time with a mortar consisting of one part cement to two parts of fine aggregate. Form markings should be erased.

Joints

Expansion joints must be completely filled with a minimum of one-half inch of preformed expansion joint filler. The joint filler material is set-in the forms prior to placing the concrete. Care should be taken that the expansion joint material is not displaced from its location and that it remains vertical.

Curing

Concrete that dries too soon will not have a lasting durable finish or the necessary strength. If a curing seal is used, be sure it is applied slowly enough and at a steady rate so all surfaces are uniformly covered.

Asphalt Curbs

Sometimes it is necessary to make adjustments to the mix. In some cases, a gradation on the fine side of a standard mix is preferable. Also, in many cases, it is found that the temperature of the mix at time of placement is critical. An excessively hot mix may tend to flow, while a mix on the cold side may be difficult to work.

Precast Concrete Products

(554)

Construction Requirements

(554.03.3) and (551.03.3)

Batching and mixing requirements are covered by applicable sections of the Standard Specifications. The requirements for scales and water meters are the same as for other concrete production.

Full-time inspection batching is not required where concrete is produced on-site at an established plant. In this case, batching operations should be checked periodically during each days production.

A batch plant inspector is necessary when concrete is produced off-site and transported to the job site for placement.

Most precast concrete products are cast in metal forms. They are durable but can be dented and racked out of shape and alignment. Poor fit between parts can cause grout loss and rock pockets. Defects such as these should be corrected before production. Cleaning and oiling with the proper form oil after each use is necessary to secure acceptable concrete surfaces with steel forms. Items with deficiencies caused by form defects are subject to rejection unless they can be satisfactorily repaired.

We attempt to maintain our standards for precast items consistent with those of surrounding states. Requests to use forms fabricated to another state's standard are frequently received. These usually can be approved provided there is no problem with fit or interchangeability. An example is concrete barrier sections. The end forms may be fabricated for a different wire loop spacing in the ends. The sections will not interchange with our standard section unless additional end block outs are provided.

Several precast concrete items such as curbs and barrier rails are exposed to very severe conditions. Adequate entrained air is at least as important to durability as strength. Air tests should be made frequently. Placing and vibrating concrete in lifts will help reduce air holes.

Curing

(554.03.6)

There is no specified cure time for precast concrete products. Cure time is instead based on the strength test cylinders cured with and under the same conditions as the item. Curing and protection must continue until the cylinders reach the required strength.

Inspection

Precast concrete products are generally stamped with a Circle M. This is intended only to indicate it was inspected at the plant. The plant inspector should apply the Circle M only when a member or piece is complete in all respects. Final acceptance of precast concrete will be in the field as with any other manufactured item. Consultants retained by the Department may have their own unique stamp and may use it to signify plant acceptance.

Fence

(607)

General

The three most common types of fence are: chain link fence, woven wire fence, and farm fence. Chain link fence is used most often within city limits, but it is also used in rest areas and other special cases. Woven wire fence is used mainly for right-of-way boundary fence in rural areas on Interstate projects. Farm fence, as its name implies is used to replace existing barbed wire farm fences, or to enclose previously unfenced land along the right-of-way on primary and rural roads. Either barbed or woven wire may be used.

Fence location, length to be fenced, and when the fence will be constructed concern adjoining land owners as well as the State. A discussion should be scheduled with the land owners as soon as possible.

Materials

Materials that have been inspected by a representative of the materials laboratory at the place of production should have a "circle M" stamp and be supported by test reports. Materials that have not been tested should be carefully examined on the job. Any damaged material, including material with a "circle M" stamp may be rejected.

Construction

(607.03)

Layout

Review the standard drawing pertaining to the type of fence being constructed for guidance in layout work. The right-of-way plans will show the same requirements as the right-of-way agreements or allow for construction according to these agreements.

Try to set the distance between panels at intervals of 16.5 feet so that an even number of rods will be used. When this can not be done, the odd length should be absorbed near the center of the run (rather than at the end) by increasing the spacing of a few posts.

After the fence alignment has been reviewed and staked, the contractor will clear the ground of all obstructions. A bulldozer may be used, but unnecessary clearing should be avoided.

Setting Posts

Before the concrete takes its initial set, each post should be plumb, and checked for elevation and alignment.

The top of the concrete should be crowned for drainage. The concrete should be allowed to cure for at least 7 days prior to stretching wire or putting stress on the post.

Installing Wire

Wire should be one to two inches above the ground for chain link fence; three inches for woven wire fence; and nine to sixteen inches for barbed wire fence.

When stapling woven wire, the top and bottom wires on each post should be stapled first. A uniform tight fence can be obtained by starting midway between corners or ends, and stapling toward each end.

On level ground, and over knolls, the staple should slope slightly downward. In a draw where the wire tends to lift, the staple should slope upward into the post.

Staples should not be placed over or next to the barb or stay wire. Sufficient clearance should be provided to allow for free movement through the staple. This will allow for expansion and contraction.

The wire at the ends where it is tied off should be stapled and wrapped around the post, then fastened back on itself. Enough barbs or stays should be removed to allow for wrapping the wire around the post and for making a tight wrap-splice back on the wire.

When multi-strand barbed wire fence is to be attached to an anchor post, the top wire should be attached first. This method will put the maximum pull on the top of the anchor post. The lower wires can then be added without loosening the first wires.

Inspection and Records

Inspection on a full-time or part-time basis will depend on the speed and location of the work under way. Some jobs have fence work under way at numerous locations and may require a full-time inspector. On other jobs, the inspector may need only to check the work from time to time during each day.

Records of fence construction should show the number of rods of completed fence; beginning and ending stations; number of gates, panels and deadmen installed; and the number of hours of dozer work done.

Pneumatically Applied Mortar (See Special Provisions)

General

Pneumatically applied mortar (most commonly referred to as "shotcrete") is a combination of portland cement, water and sand that is conveyed through a hose by compressed air and ejected at high velocities onto a surface. The mixture is relatively dry and is capable of supporting itself without sagging or sloughing, even when it is applied on vertical or overhead surfaces. Usually, it is applied in successive applications. This results in a built-up surface. Manufacturers of equipment and others have used a variety of names, such as gunite, sprayed concrete, spraycrete, air blown mortar and shotcrete to describe pneumatically applied mortar.

Pneumatically applied mortar can be shot readily on surfaces that are composed of various materials, regardless of the shape or slope of the surface. It has found extensive use in the repair and strengthening of buildings, as a protective coating on structural steel, masonry, rock, concrete beams and various applications that need thin linings. Shotcrete is also quite suitable for a variety of new construction. The

success of its use is very dependent on the capability and competence of the crew doing the application work, the correct preparation of the surfaces onto which it is placed, the method of placement and the capability of the particular equipment used.

Shotcrete does not contain coarse aggregate so much more cement is used than would be used in the same volume of concrete. This extra cement also increases the water requirement and causes the mortar to crack easier. There is no entrained air in this mortar, so it is less serviceable in comparison with air entrained concrete. This lowered durability is especially serious in areas where freezing and thawing occur in regular or frequent cycles.

Application Processes

Dry Mix Process

With this process, the cement and damp sand are thoroughly mixed, introduced into a special mechanical feeder, metered by a feed wheel into the delivery hose and carried by compressed air through this flexible hose to the discharge nozzle. Water is introduced through a second hose entering the discharge nozzle and all ingredients are intimately mixed as the mortar is jetted out at high velocity.

Wet Mix Process

This process consists of thoroughly mixing the sand and cement with water, introducing the complete mixture into the chamber of the delivery equipment, through the flexible hose to the discharge nozzle. At this point, additional air is injected, and the mortar is jetted from the nozzle at high velocity on the surface to be mortared.

Surface Preparation

Such earth surfaces as those exposed in canal linings, roadside ditches, backslopes, etc., should be kept damp for several hours before applying the shotcrete. Mortar should not be applied on any surface that is frozen, spongy or containing free water.

Shotcrete can be used to repair deteriorated concrete if all of the unsound material is first chipped off and the area sandblasted to clean the concrete and exposed steel. All edges should be rounded and/or tapered.

Concrete surfaces should be thoroughly cleaned, followed by wetting and damp drying. Surfaces that are sound but porous should be kept damp for several hours before applying mortar.

Surfaces composed of solid rock should receive an air-water treatment to clean cracks and remove loose rocks.

Applying Mortar

Mortar is sprayed on the area by holding the nozzle between two and five feet from the work, and building up each layer of the mortar by making several passes with the nozzle over the working area. The nozzle is usually held perpendicular to the surface, except when an encasement of reinforcing bars is to be sprayed. For reinforcing bars, the nozzle should be held a little closer and at a slight angle from the perpendicular to permit better coverage and help in the removal of rebound.

The thickness of each layer being placed is determined by how much can be placed without sagging. When placing mortar on walls, the application should begin at the bottom. The first layer placed should at least completely embed the reinforcement that is adjacent to the form.

When coatings of one inch or more of thickness are to be applied to vertical or nearly vertical surfaces, two or more layers should be used, each layer being no more than three-fourths of an inch in thickness. Thicker layers might sag or slough. Level or slightly sloping surfaces can be covered in a single layer up to a maximum of three and one-half inches.

As the placed mortar begins to cure and set, a glaze coating appears which is a deterrent to a good bond. When more than one layer is applied, a delay of approximately 30 minutes to an hour between applications is usually sufficient to prevent sloughing, yet not so long as to allow a glaze to form.

Forms

Where forms are required, they should be made of plywood sheeting or other suitable material, positioned true to line and grade and adequately braced to ensure protection against excessive vibration. Forms should be constructed to permit the escape of air and rebound during the placing operation, especially in the case of thick structural members. When forms are used, they should be oiled or dampened and thoroughly cleaned just prior to their use.

Reinforcement

Reinforcing steel will be used on many of the jobs requiring mortar. Sufficient clearance has to be provided around the reinforcement to permit complete encasement with sound mortar. Wire mesh should be positioned so that the mortar can be sprayed or shot in at a slight angle from opposite sides if needed. All reinforcement should be clean and free from loose mill scale, loose rust or similar coatings that might interfere with bonding of the mortar. Reinforcement bars should be separated by at least two inches wherever possible.

Alignment

Control of alignment and grade must be accurate to establish the thickness and surface planes when constructing corners of walls, columns, beams and similar work. Precise control of horizontal or vertical alignment is not usually required for such mortar work as lining highway ditches, backslopes, rock embankments or placement under bridges. For these types of projects, an 18- or 20-gauge hard steel piano wire is recommended for use as an alignment device.

Rebound

Mortar particles that bounce off surfaces during spraying are referred to as rebound. Rebound should be cleaned from the surface before application.

Finishing

The natural finish left by the shotcrete operation is usually preferable, both for strength and durability. Further finishing should be avoided because it might disturb the bond between the mortar and reinforcement or underlying material and it might create cracks in the mortar. Where the natural finish is unacceptable, special finishes might be applied. A smooth finish can be made by brooming after the mortar has taken its initial set. A much finer finish with better appearance can be made by applying a thin surface coating containing finer sand than normal and making the application with the nozzle held well back from the work. This type of finish should be applied as soon as possible.

Temporary Erosion and Sedimentation Control

(208)

Surface Protection of Exposed Soils

General

All slopes of 2:1 and steeper should be mulched to protect them from precipitation as soon as they are shaped.

Vegetation and mechanical control measures should be used concurrently. Although all bare, erodible soils require surface protection, particular emphasis should be placed on protecting long, steep slopes, and areas where run-off water can concentrate.

Mulches are usually applied in conjunction with seeding operations. There are cases, however, where a slope needs protection before it can be seeded, and the temporary erosion control may have to be removed before seeding the slope.

Mulches

Spreading material on slopes with a pneumatic mulcher, a hydroseeder, or hand broadcasting is common practice in establishing grass. The addition of a mulch is expensive and is not always necessary to establish grass. Mulch is particularly useful, however, in establishing grass on harsh sites.

Mulches are an erosion and siltation preventive measure as well as a measure to conserve moisture for seedling establishment. There are several commonly used mulches:

1. ***Wood Fiber***. Wood fiber applied at a rate of 1,500 pounds per acre works well except in areas where heavy frost heaving or excessive surface water exists.
2. ***Straw-Asphalt***. This type of mulch is susceptible to being carried away by wind and water. Straw is often contaminated with grain and weed seeds that prevent newly planted grass seedlings from growing. Straw-asphalt mulch establishes better stands than wood fiber where frost heaving is a problem.
3. ***Macerated Paper***. Macerated paper is applied as a slurry. This type of mulch is not as long lasting as wood fiber or straw-asphalt.
4. ***Soil-Anchored Mulch***. Straw or hay can be distributed uniformly over the surface and held in place by punching it into the soil with a mulch tiller, a sheepsfoot roller, or a disk. It is not necessary to cover the seed prior to using this method.

5. ***Gravel.*** Gravel mulch is used primarily where desert conditions or wind erosion prevail, and where establishing vegetation is almost impossible. This type of mulch, applied to a depth of 2 inches, modifies soil temperature extremes, conserves moisture, and restricts erosion.

Mats and Mesh Covers

Some areas are subject to severe wind or water erosion and must be securely protected prior to plant establishment. Such protection can best be brought about by the use of mats or mesh covers.

1. ***Jute Mesh.*** Jute mesh is effective in establishing seedlings but is expensive and laborious to apply. If not properly applied, water will run beneath the mesh and create gullies. Jute mesh is long lasting and may be justified on unstable soils or in critical drainage areas.

2. ***Excelsior Mat.*** This is effective for temperature modification and moisture conservation. Although it can work better than straw-asphalt because it is not contaminated with weed and grain seed, it decomposes more quickly. This mat may also attract mice which feed on the grass and shrub seedlings during the winter.

3. ***Fiberglass.*** Random application of fiberglass filaments, tacked with asphalt, effectively prevents erosion of ditches prior to establishing permanent vegetation.

4. ***Plastic Sheeting.*** Plastic sheeting can provide a great deal of protection from the wind and rain, if it is securely anchored and keyed into the surface.

5. ***Sodding.*** Sodding is an effective method of controlling erosion in moderate graded ditches and steep slopes. It is the only way that permanent vegetative erosion control can be installed and be effective immediately. However, sodding is expensive. Its rarely used because seeding and mulching can eventually produce the same results for less money.

Control of Run-off Water

Control of run-off can be accomplished by the installation of temporary diversions, berms, slope drains, or flow barriers.

Run-off Diversion

The first requirement in stabilizing cut and fill slopes is to prevent run-off from flowing over the face of the slopes. Diversion structures such as temporary compacted earth embankment, bales of straw, ditches, and furrows that can quickly be constructed can be used to intercept run-off before it reaches erodible areas. They decrease the velocity of the run-off and channel the water toward erosion-resistant natural or artificial drainage ways than can carry it out of the construction site. Particularly critical areas for the installation of diversions are at the crests of cut and fill slopes where they can prevent run-off from gaining access to the slope.

1. ***Temporary Curb***. Temporary curb may be constructed of any material available that will divert run-off from the erodible slope. It may be necessary to install a temporary curb to direct run-off coming from the relatively flat surface of an equipment yard, borrow area, or incomplete cut or fill, into a sediment trap.

2. ***Berms***. Berms or broad benches, sloping inward, placed at contour intervals on a slope will decrease the length of the slope and divert run-off into slope drains. It can then be discharged into non-erodible or protected areas.

Slope Drains

Slope drains are used to carry water from diversion structures and the upper part of slopes to lower areas or into channels where the energy can be dissipated. Portable and flexible neoprene tubes are excellent for temporary use.

Other types of slope drain channels may be used. In all cases, care should be taken to ensure that the discharge does not cause erosion. Energy dissipating structures or sediment traps may be required in conjunction with slope drains.

Trapping of Sediments

Sediments carried by flowing water can be trapped behind small temporary barriers or in large sediment basins or reservoirs which decrease the velocity of flow below that necessary for sediment transportation. Barriers used may be impervious enough to stop completely the flow of water or may consist of semi-pervious materials such as sand, gravel, brush, or bales of hay. In the latter cases, the barriers also act as a filter which allows the movement of water but retains most of the sediment load.

The size and cost of structures to trap sediments vary more widely than others used for sediment control purposes. Barriers range from small temporary dikes to large earth dams which are engineered to specified requirements. Large impervious barriers for sediment basins are constructed with uncontrolled outlet pipes extending under or through them. After the water has deposited its sediment load in the reservoir, it can escape through the riser pipe which extends above the sediment storage level. Very large barriers and sediment basins are used where rainfall is seasonal and construction is detained for long periods of time. Semi-pervious barriers may consist of a dike, formed by bales of hay staked to the ground, and a low spillway-embankment section of sand and gravel that permits slow movement of water through it. These types of barriers are usually small and quickly constructed in areas where rainfall is more uniform and storm periods fairly short.

When temporary sediment basins are no longer needed and must be removed, removal should be done only after all accumulated sediment has been cleaned from the basin. The berm or dike that forms the basin must be removed in such a manner that the removal operation itself is not a source of sedimentation.

Records and Documentation

Complete records should be maintained including materials and equipment used, location and nature of the work, dates for staking and installation, and inspectors signatures. Force account records should also be kept on maintenance and removal of all temporary erosion and sedimentation control devices.

Traffic Control

(618)

References

Manual on Uniform Traffic Control Devices

Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) sets forth the basic principles and prescribes standards for the design, application, installation, and maintenance of the various types of traffic control devices required for road or street construction. These include signs, signals, lighting devices, pavement markings, barricades, and channelizing and signaling devices. Minimum standards of application are prescribed for typical situations and for methods of controlling traffic through work areas. The protection prescribed for each situation is based on the speed and volume of traffic, duration of operation, and exposure to hazards. Traffic control on all projects at all times must be in conformance with Part VI of the MUTCD and the Construction Signing Standards.

Construction Signing Standard Details

Theses drawings cover many construction signing situations. They do not cover every situation. Therefore, each situation should be carefully reviewed to determine if the traffic control should be modified. The drawings are considered to be minimum. If additional traffic control is needed, it can and should be added.

The drawings have been developed in accordance with Part VI of the MUTCD; therefore, any modifications must also be in accordance with the MUTCD.

Traffic Control Plan

A Traffic Control Plan (TCP) is a plan for handling traffic through a specific highway or street work zone or project. A TCP may range in scope from a detailed plan designed solely for a specific project to a reference to standard drawing or a section of the MUTCD. The degree of detail in the TCP will depend on the project complexity and traffic interference with construction activity.

As soon as plans for the project are received (prior to the letting) in the District, the TCP should be reviewed by the District Construction Engineer, District Traffic Engineer, and the Engineering Project Manager. The purpose of this review is to see if any changes in the TCP should be made prior to the letting. All changes should be coordinated with the Contract Plans Section in Helena.

Surveillance of Traffic Control

General

There are a number of things the Engineering Project Manager can do to ensure that the traffic control is functioning as intended.

One of the best indicators is to drive through the project to see if anything appears confusing. Obvious indications of a problem include: the same device or devices frequently struck by vehicles; skid marks; damaged guardrail; and conflicting devices, signs, or markings.

Daily

Traffic control should be reviewed every day, and more often as needed. As the construction work progresses, conditions affecting traffic control can change resulting in need for adjustment of traffic control devices.

Nighttime

Traffic control devices and pavement markings that are adequate during the day sometimes are not adequate at night — especially at night during rain or snow conditions. Reflectivity of signs and the clarity of striping are especially important items to inspect at night.

Holidays

The Engineering Project Manager should ensure that there is sufficient monitoring of traffic control during holidays. Any devices damaged or out of place have to be replaced as soon as possible.

Adverse Weather

Rain, fog, and snow can greatly affect traffic control on a project. Therefore, monitoring during periods of adverse weather has to be done to ensure as safe a project as possible.

Informing the Public

Accurate, timely publicity can have a very beneficial effect on traffic behavior on a construction project. A motorist who is forewarned of construction conditions will be more tolerant of delay and inconvenience and probably be more alert and responsive to construction zone control.

The Engineering Project Manager should ensure that information on road closures, opening new roads, rerouting of traffic, and any change in traffic conditions on the project is made available in advance for local publicity in accordance with the District's instructions for distribution of news releases.

Emergency conditions (washouts, impassable roads caused by flooding, land slides, etc.) on the project may require the Engineering Project Manager to authorize the immediate closure of a construction project to traffic for the protection of life and property. When such urgent and emergency conditions prevail, the Engineering Project Manager should contact the District Construction Engineer as soon as possible. The District Construction Engineer will then make all notifications necessary to inform the public and proper officials.

Informing the Highway Patrol

Traffic control will be more effective if the Engineering Project Manager cooperates closely with the Highway Patrol. The Highway Patrol should be notified in advance of the start of construction operations to arrange for a joint inspection of the traffic control devices. Other inspections should be scheduled as work on the project progresses and traffic control requirements change. The Highway Patrol should be requested to inform the Traffic Controller of any deficiencies he notes on his travels through the project.

Documentation

A separate traffic control diary shall be kept by the person designated to be in charge of the project's traffic control. This notebook shall contain the following:

- Records of inspections giving date, time of day, results of inspections, instructions to contractor concerning the Traffic Control Plan, traffic control devices, and any action taken by contractor.
- Results of inspections conducted by the District Construction Engineer, Helena Headquarters personnel, or FHWA and action taken during and after inspections.
- Results of meetings with the Highway Patrol and other law enforcement officials.
- Location and date of placement of signs and other traffic control devices.
- Record all accidents and note date, time, and location accident occurred.

Appendix

Construction Bureau Forms and Reports

TABLE OF CONSTRUCTION BUREAU FORMS & REPORTS

Form No.	Name of Form	Purpose	Prepared By	No. of Copies & Distribution	Special Instructions or Notes about Form
▲ BR-10A	Footing Log	To document and transmit information on foundation conditions for structure spread footings.	As designated by Proj. Mgr.	1 copy–Proj. Pay Quantity Notes 1 copy–Dist. Engr. 1 copy–Const. Bureau	See Bridge Construction Manual. May be submitted by phone or fax if urgent.
▲ BR-16	Test Pile Notes	To transmit test pile data for setting service pile lengths.	As designated by Proj. Mgr.	1 copy–Proj. Files 1 copy–Dist. Supr. 1 copy–Const. Bureau	See Bridge Construction Manual. May be submitted by phone or fax if urgent.
▲ BR-21	Test Pile Field Notes	To record test pile field data.	As designated by Proj. Mgr.	1 copy–Proj. Pay Quantity Notes	See Bridge Construction Manual
▲ BR-22	Service Pile Field Notes	To record service pile data for pay quantity and documentation.	As designated by Proj. Mgr.	1 copy–Proj. Pay Quantity Notes	See Bridge Construction Manual
C-1 Rev. 1-26-81	Notice to Contractor of contractor proposal acceptance	To notify the contractor he has been awarded the contract.	Admin-Engr. Div. Helena	Shown on Form	
C-2 Rev. 1-26-81	Notice to Contractor to proceed with work	Shows date contractor is expected to begin work and from which date contract time will be charged.	Const. Engr. Helena	Shown on Form	Effective approx. 20 days after contract is awarded.
▲ C-8 10-13-66	Progress Estimate Worksheet	Items for which an estimate amount must be determined for the progress estimates are calculated on work-sheets. Examples are excavation and lump sum items. Worksheets then serve as documentation for these quantities.	Project Mgr.	Retained in Proj. File & submit as part of notes.	
CB-7 4-78	Utility Claim	Documents utility relocation details, utility claims, and railroad flagging costs.	Proj. Mgr.	Original and 3 copies to Utilities	
CB-12 A, B Rev. 3-78	"Extra Work" & "Extra Material" Order (Force Account)	Documents & establishes the basis of payment for work not contemplated under original contract.	Proj. Mgr.	Original to Const. Bureau with all necessary supporting data.	
▲ CB-13 Rev. 9-82	Change Order	Documents changes in plans, specifications, eliminated items, agreed price changes, quantities of items, proposed equipment usage, specified materials, and other allowed changes in the work as described in the contract.	Proj. Mgr	Original to Const. Bureau with all necessary supporting data.	

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Form No.	Name of Form	Purpose	Prepared By	No. of Copies & Distribution	Special Instructions or Notes about Form
▲ CB-14 ▲ CB-14A	Estimate	To record the amount of work performed by the contractor during a certain time period & to determine the payment due the contractor for this work.	Proj. Mgr.	Shown on Form	
▲ CB-15	Assessment of Contract Time	Documents time that is assessed against the contract during the week covered by the report.	Proj. Mgr.	Original to Const. Bur. with all necessary supporting data.	
CB-18 7-1-77	Map Information Sheet	To be attached to Reclamation Plan. Provides supplemental information regarding material sources.	Contractor submits to Proj. Mgr.	Copies to Const. Bur. Dist. Const. Engr.	
CB-21 Rev.	Utility Work Order	Documents over-runs & additional work required but not provided for under original agreement. Documents utility work required but not covered by a previous agreement.	Proj. Mgr.	Shown on Form	
CB-30QA 1-83	Proposed Job Mix Aggregate Gradation	Records Contractor's proposed job mix aggregate gradation. Replaces CB-30 on projects with Quality Assurance (QA) Specifications.	Contractor submits to Proj. Mgr.	Approved copies to Matis. Bur. & Const. Bur.	Submitted after a representative volume of aggregate material has been produced.
CB-30A	Design Mix Supplement To Job Mix Aggregate Gradation	To develop mix design from Contractor's produced aggregate.	As designated by Proj. Mgr.	1 copy–Proj. Mgr. 1 copy–Dist. 1 copy–Const. Bur. 1 copy–Matls. Bur.	Prepared by Dist. personnel & submitted at the time samples are submitted for a design mix. Attached to an approved copy of Form CB-30.
CB-40 A, B	Estimate Worksheet Materials in Storage	For figuring amount due contractor for materials in storage.	Proj. Mgr. or as designated	Proj. Files	Payment will be made only for materials on designated list at set percentages.
CB-50	Notice of Potential Claim	For Contractor to notify Project Mgr. of claim.	Contractor employee submits to Proj. Mgr.	Proj. Files Dist. Office Original to Const. Bur.	This form will be submitted to Proj. Mgr. within 24 hrs. after being informed by Contractor.

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Form No.	Name of Form	Purpose	Prepared By	No. of Copies & Distribution	Special Instructions or Notes about Form
CB-51	Cost Record of Potential Claim	For Contractor to keep track of claim's additional cost.	Contractor employee submits to Proj. Mgr.	Proj. Files Dist. Office Original to Const. Bur.	This form required to be submitted by Contractor. Required to submit this form within 30 days of filing CB-50. Required to update form every 30 days.
▲ CB-53	Plant Mix Daily Acceptance Tests	Document compaction of plant mix material for QA specifications.	Proj. personnel—signed by Contractor and Proj. Mgr.	Proj. Files Dist. Office Original to Const. Bur.	This form used to figure amount of price reduction and incentive allowance on campaction of plant mix material.
▲ CB-55	Plant Mix Surfacing Aggregate	Document aggregate gradation of plant mix for QA specifications.	Proj. personnel—signed by Contractor and Proj. Mgr.	Proj. Files Dist. Office Original to Const. Bur.	This form used to figure price adjustments for plant mix surfacing aggregates.
C-P-1 Rev. 7-1-83	Project Personnel Assignment Authorization (to be used for assignment to project on temporary or permanent basis)	Authorizes Acctg. Bureau to make payment for expenses.	Dist. Const. Engr.	Shown on Form	See current permanent residence & field expense policy.
C-P-2 Rev. 7-1-72	Project Personnel Assignment Authorization (to be used on permanent change of residence from one Dist. headquarters to another or to Helena headquarters)	Authorizes Acctg. Bureau to make payment for expenses.	Dist. Const. Engr.	Shown on Form	See current permanent residence & field expense policy.
C-P-3		To determine eligibility for secondary quarters or commuter allowance.	Person applying for secondary quarters or commuter allowance.	Shown on Form	
CSN-01	Construction Staking Form	Recording all original and remeasure cross section notes.	Engr. Tech. or note keeper	Kept in Proj. Files as permanent record.	
CSN-02	Basic Note Keeping Form	Recording notes for most contract pay items.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	
CSN-03	Direct Solar Observation	Recording notes when making direct solar observations.	Note Keeper	Kept with other notes of location survey.	
CSN-06	Lined Note Paper				
CSN-07	Transit Note Paper	Recording survey transit notes.	Engr. Tech. or note keeper	Kept in Proj. Files as permanent record.	

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Form No.	Name of Form	Purpose	Prepared By	No. of Copies & Distribution	Special Instructions or Notes about Form
▲ CSN-12	Statement of Daily Force Account Work	Daily record of all labor, equip. and material used on force account basis.	Proj. Mgr. or inspector	Kept in Proj. Files as permanent record.	Form must be signed at end of last shift by inspector and Contractor.
▲ CSN-25	Culvert Note Form	Recording notes for installation of culverts for pay quantity and documentation.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	
▲ CSN-26	Surfacing Note Form	Maintaining aggregate surfacing records.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	
▲ CSN-27	Seeding Note Form	Maintaining seeding and fertilizing records.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	
▲ CSN-28	Signing Note Form	Recording notes for installation of signing for pay quantity & documentation.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	
▲ CSN-50	Rolling Equipment Record	Used to document all rollers on project when rolling unit is a pay quantity. Unit values are recorded on this form.	Proj. Mgr. or inspector	Kept in Proj. Files as permanent record.	
▲ CSN-51	Rolling Record	Data from rolling card is entered on form & running total of units is computed for pay quantity purposes.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	Refer to Form CSN-51 for roller unit value
▲ CSN-54	Water Record	Data from water punch card is entered on this form & running total of water computed for pay quantity purposes.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	Must have inspector's written signature.
▲ CSN-55	Blasting Record	Used to record method, location of blast area, quantity & type eqip. & materials used.	As designated by Proj. Mgr.	Copy to Helena headquarters, Geology Section.	
5	Gravel Punch Card	Documents quantity of materials delivered to project by each hauling unit.	As designated by Proj. Mgr.	Kept in Proj. File as permanent record.	Used when hauling units are loaded uniformly. Two cards are retained for validation & documentation. One card signed by scaleman & one by roadman. Requires written signature.

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Form No.	Name of Form	Purpose	Prepared By	No. of Copies & Distribution	Special Instructions or Notes about Form
124	Gravel Ticket	Documents quantity of material delivered to project by each hauling unit.	As designated by Proj. Mgr.	Kept in Proj. File as permanent record.	White–Contractor copy. Scaleman & roadman validate Yellow–road copy. Scaleman & roadman validate. Pink–scaleman copy. Scaleman validate. Written initials required for all copies.
158	Report of Completion of Special Authorization	Used when material is taken over by the State from the Contractor & placed in State stores.	Dist. Const. Engr.	3 copies to Helena Maintenance Division.	
LC-1	Employees Spot-Check Interview	Used to record information found in spot-check interviews made to determine compliance with labor provisions of contract.	Proj. Mgr.	1 copy retained in Proj. File. 1 copy to Civil Rights.	See Article 415-4.6 of Labor Manual
LC-2 6-84	Labor Complaint Form	Information on form used in investigation of labor complaints.	Contractor employee submit to Proj. Mgr.	1 copy to Civil Rights	Se Article 415-4.7 of Labor Manual.
LC-3 Rev. 7-83	Engineers Payroll Check List	Used by Proj. Mgr. as check to determine compliance of payroll with contract provisions.	Proj. Mgr.	Original attached to weekly payroll submitted to Civil Rights.	See Article 415-4.3 of Labor Manual.
LC-7	Payroll Register	Used by Proj. Mgr. as convenient way to check status of weekly payroll submission.	Proj. Mgr. or as designated	Kept in Proj. Files	Form is used for each prime & subcontractor on project.
PR-47 Rev. 6-78	Statement of Materials & Labor used by Contractors of Highway Construction Involving Federal Funds	Completed form is required before FHWA can make final acceptance of project. It is used for tabulating nationwide cost indexes. Form FHWA-47 should be transmitted for each Federal-aid primary, urban and Interstate system project involving construction performed under contract awarded by competitive bidding, except projects for which the total final construction cost of roadway and bridge is less than $1,000,000 or projects consisting primarily of (1) the installation of protective devices at railroad grade crossings, or (2) highway beautification.	Dist. Const. Engr.	Original to Helena	Part A completed by Dist. Const. Engr. Part B completed by Contractor.

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Form No.	Name of Form	Purpose	Prepared By	No. of Copies & Distribution	Special Instructions or Notes about Form
R/W Form 37-B Rev. 3-81	Pit Release Statement	Form certifies that all conditions set forth in pit agreement with land-owner have been satisfied.	Proj. Mgr. Signed by owners & Proj. Mgr.	1 copy–Dist. 1 copy–R/W Bureau 1 copy–Const. Bureau	Form must be completed for all State-optioned borrow or gravel pits. Not necessary for pits contractor has secured.
R/W Form 72 Rev. 1-80	Permission to Enter on Private Property	Authorizes entry by engineering crews onto private property.	Proj. Mgr. or R/W personnel–signed by Landlowner.	1 copy retained by Dist.	
	Affidavit	The affidavit releases the Department from reclamation responsibil-ity only after the landowner has obtained a reclamation contract with the Department of State Lands.	Proj. Mgr. R/W & signed by Landowner	Forward to Const. Bureau	
Rev. 1-12-84	Certificate of Comple-tion of Construction Contract	Officially notifies the contractor that a final inspection has been made & that the work under his contract is complete and accepted.	Dist. Const. Engr.	Shown on Form	
	Mileage Comparison	Informs Preconstruction of changes in actual length of project. Subsequent projects can be planned accordingly.	Proj. Mgr.	3 copies with final estimate	
	Report of Start of a Major Phase of Work	Notifies Helena that construction has started on a major phase of a project.	Dist. Const. Engr.	1 copy to Helena	Report should be made when work starts on utilities, grading, aggregate surfacing and plant mix surfacing.
	▲ Traffic Control Notes	Documents quantity of traffic control items used by contractor during shift.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	Form must be signed at end of last shift by inspector and contractor.
	Water Punch Card	Documents quantity of water delivered to project by each truck/shift. Data is entered on Water Record.	As designated by Proj. Mgr.	Kept in Proj. Files as permanent record.	Must have inspector's written signature.

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