

Public Works Inspectors' Manual

PART 1

GENERAL INFORMATION

1-1 INTRODUCTION TO PUBLIC WORKS CONSTRUCTION INSPECTION.

1-1.1 GENERAL

Information in this part of the Manual is designed as an introduction to public works construction inspection. Technical information is contained in Parts 2 and 3. Included are general policies and procedures for construction inspection and contract administration agencies as well as information designed to familiarize Inspectors with their duties and responsibilities.

Agency Inspectors must work constantly to achieve a high standard of excellence in the administration and quality assurance inspection of public works improvement contracts. The accomplishment and stature of the Agency must inevitably stem from the individual commitment and performance of each employee, and each individual's responsibility to perform in such a manner that personal goals and the Agency's goals are not in conflict.

The Agency must deal effectively with a relatively difficult control and communication situation. Inspectors are widely dispersed to various project sites and spend the entire workday there. Isolated from immediate supervisory resources and control much of the time, the Inspector must literally make hundreds of individual judgments affecting the quality of construction. Under these circumstances, Agency management must ensure that Inspectors maintain the feeling of being a part of, and responsible to, the organization and that they have its support. Communication is vital under these conditions and the Inspector and Agency management must utilize all available resources and opportunities to discuss and resolve problems as they arise.

Inspectors must be familiar with the function and purposes of other organization elements and groups of the Agency and the relationship they have to their own immediate area of participation and responsibility. With such understanding, the Inspector can utilize support of these other groups in the process of accomplishing the work of the Agency.

Inspectors must be motivated to increase their personal knowledge and skills and stay informed regarding the latest construction materials and techniques.

Ideally, Inspectors at project sites are leaders who gain the confidence and respect of the people they are dealing with by demonstrating their knowledge and ability. Inspectors do not depend solely on the rights and powers vested in them by the Agency because they know that such an exclusive and arbitrary approach is not likely to produce the desired result.

Inspectors should consider the Contract between the Contractor and the Agency as a “partnership” responsible for providing quality construction which will perform well throughout its design life.

Inspectors must have a thorough knowledge of the project or phase of work to which they are assigned.

Inspectors must know sound construction methods and the latest techniques for their implementation.

Inspectors must be experienced in all aspects of standard inspection and testing procedures and coordinate their or her work with the Contractor or the Contractor’s representative so that the combined effort will produce the specified quantity and quality required by the Specifications.

Inspectors must be timely, but not hasty to condemn unsatisfactory work. However, once they are aware of work that endangers the quality, they must be firm in insistence on corrective action. Inspectors must keep in mind that an order to “tear it out” is sometimes necessary, but realizes such action often is of questionable benefit to the public, and may not be cost-effective when considering the cost in delay, inconvenience and eventually in money represented by rising construction costs on future work.

The Inspector’s purpose can be summarized as follows:

- To serve as the eyes and ears of the Agency
- To verify that the final field product meets the requirements of the Contract Documents
- To verify quantities for payments to the Contractor
- To deal with the public and other entities affected by the Work

1-1.2 Legal Aspects of Construction Inspection.

Federal, state and local laws require detailed and continuous inspection of all work which is paid for with public funds or which is performed in public right-of-way. These laws gradually developed as a safeguard against the natural tendency of individuals or groups to divert portions of the benefits to themselves.

Inspectors are the representatives of the Agency at the site of the Work who are empowered to enforce the provisions of the Contract Documents or permit. Inspectors are authorized to reject materials and workmanship not in conformance with the Contract Documents or permit requirements. Inspectors should be aware of the policies of the Agency regarding their authority to make changes in the Work.

1-1.3 Characteristics and Training of the Inspector.

Inspectors must be mature, confident, patient, meticulous in carrying out their duties, and possess both integrity and good judgment. Inspectors should have practical experience in construction and possess an understanding of the principles involved, as well as have a thorough knowledge of the interpretation of the Plans and Specifications, and construction contract administration.

To be successful, the Inspector must have a character and personality of such strength as to merit the respect of those with whom they work. Inspectors must be firm but fair in their decisions and follow through to ensure that they obtain compliance with their instructions. Inspectors should be understanding of the Contractor's problems and willing to cooperate at all times to secure acceptable work without compromise of the Plans and Specifications. Inspectors should command the respect of their associates through their knowledge of the work, impartial decisions, exercise of good judgment, their personal dress and conduct, and exemplary performance.

Inspectors must be alert and observant. They must maintain a spotless service record and conduct themselves in such a manner that reflects credit upon the Agency.

Perhaps Inspectors can be best defined by the things they are NOT. The author of the following is no longer known, but the message it conveys is as applicable as ever:

Inspectors are NOT designers, although by interpreting the Plans and Specifications, they must know what the designer is trying to do. They are quite often consulted by the designer and rightly so.

Inspectors are NOT surveyors, yet they must often suggest that the surveyor approach the problem from a particular angle. In this way, they often solve the problem of proper surveying.

Inspectors are NOT superintendents, yet they must be of that same caliber and know construction and all its problems. Inspectors must have all the foresight of a good superintendent in that they must be aware of and appreciative of good job planning and scheduling. Conversely, they should be on the alert against those inescapable results of bad planning.

- Inspectors are NOT policemen, yet they must ensure compliance with the law.
- Inspectors are NOT lawyers, yet they must know and enforce the requirements of applicable laws, ordinances, and regulations.
- Inspectors are NOT carpenters, cement finishers, or mechanics; yet they must know when such craftsmen are qualified.

1-1.3.1

The Toughest Job In Construction.

The toughest job in construction is that of "Inspector." The Inspector is the vital link between what the designer conceives and the finished product. The Inspector must work closely with the Design Engineer to ensure that the project is built in strict accordance with the Plans and Specifications. The Inspector has the authority to point out deviations from the Plans and Specifications, but has no authority to authorize even the smallest change in design.

Inspectors work with the Contractor on a daily basis and must develop a rapport with the Contractor, while at the same time be fair in their judgment and firm in their decision making. While maintaining a cooperative and reasonable demeanor on the project site, the Inspector is responsible for ensuring compliance with the Plans, Specifications, and other Contract Documents.

1-1.3.2 Experience.

Being in a position of authority for the first time is extremely difficult for most new Inspectors. It must be emphasized that this authority is not a license to abuse the power associated with it. It must be made perfectly clear that this new power and authority do not give the Inspector a free rein in requiring anything other than what is required on the Plans and Specifications.

One of the mistakes most frequently made by the new or inexperienced Inspector is that of not being certain of the requirements prior to telling the Contractor that a portion of the Work is not in conformance with the Plans and Specifications. The inexperienced Inspector must always refer to the Plans and/or Specifications before making a judgment.

If the problem is still unclear, it is of paramount importance that inexperienced Inspectors check with their supervisor and request clarification before making a decision that could ultimately cause a delay and/or result in a claim against the Agency. New Inspectors must be constantly vigilant about their demeanor and the impression they give. The new Inspector must not be thought of as a bully or inflexible by the Contractor. At the same time, the new Inspector must demand respect and cooperation. This is best achieved by knowing the requirements of the Contract Documents or Permit, and showing respect to and cooperating with the Contractor. Respect breeds respect. Inspectors must expect to be challenged by the Contractor, and react in a professional manner that reflects well on themselves and the Agency. No matter the level of expertise or experience brought to the job by new Inspectors, they must never assume the role of Superintendent on the project. It is up to the Contractor to determine means and methods of accomplishing the Work, not the Inspector. It is acceptable to offer advice, or to correct mistakes before they happen, but Inspectors must never assume that they know more than the Contractor and expose themselves to criticism or claims.

1-1.3.3 Traits of a Good Inspector.

The fundamental traits found in every good Inspector are:

Knowledge. The Inspector must bring a basic knowledge of construction to the job. Inspectors must have a working knowledge of the Plans, Specifications, construction contract administration, applicable laws, and of what is expected in the position. The Inspector must be aware of changes in materials, technology, and methods of construction.

An Inspector can never have too much knowledge about what is being inspected. It is up to the Inspector to take the initiative to learn as much as possible about their job.

Common Sense. Common sense is perhaps the most important trait of an Inspector. All the knowledge in the world will do the Inspector no good without common sense. The Inspector must be able to apply common sense to what is required on the Plans and in the Specifications. Common sense is not learned from a class or a book, and it is something that all Inspectors must bring to the job and develop with experience.

Observation. The Inspector is a trained observer. The Inspector must be observant of the means and methods of construction, and observe and learn from watching the Contractor work. Not all contractors employ the same means and methods, and the Inspector must learn that there are many different ways to achieve the end result desired.

It is much more important to recognize what is wrong with the picture than what is right. The Inspector must be able to identify work which does not conform to the Contract Documents or the Permit. In the same light, they must understand the importance of being sure before informing the Contractor.

Physical Tools. Inspectors must understand and utilize the devices available to assist them in the job. The most important tools of the Inspector are the pen and paper. Inspectors must make clear and concise records of the work being performed and must document all variations and nonconforming work. The use of a still or video camera is essential in some instances to record accidents or failures. Inspectors must be resourceful and honest in recording what happens at the Work site. An Inspector can never provide too much information about the work being performed. There is no information too trivial or unimportant. Inspectors must have a working knowledge of measuring devices, survey, compaction testing equipment, and a myriad of other tools which will allow them to properly record what happens at the Work site. Inspectors must use the Job Site Memo and the Notice of Non-Compliance to their full advantage. All important conversations, directions, and/or incidents must be recorded and, when applicable, shared with the Design Engineer and Agency management.

Courtesy. One of the Inspector's most important functions is that of informing the Contractor when work does not conform to the Plans and/or Specifications. This must be done in a courteous, timely, and professional manner. The Contractor should expect constructive criticism from the Inspector. The manner in which this is relayed to the Contractor will have a major impact on how smoothly the Work proceeds to completion. The Inspector must never get into a verbal sparring match with the Contractor. This behavior is not acceptable and only serves to erode the respect for the Inspector.

The Inspector is not required to accept verbal or physical abuse from the Contractor. Such behavior is to be reported, and if necessary, the offending individual(s) must be removed from the Work site.

Critical Thinking. Inspectors should analyze and evaluate their reason(s) for taking a certain action, and determine what value, if any, it has. Inspectors must adopt an attitude, and an approach, that ensures their practices and procedures are pertinent to the needs of the Agency, and that all actions are taken in an efficient and appropriate manner. Each Inspector should be encouraged to verify that every action taken or record processed adds value to the Work or an Agency process.

Inspectors must evaluate their inspection techniques and procedures and ensure that they are not detrimental to the mission of the Agency and that they are “up-to-date” and appropriate.

1-1.3.4 Improving the Inspector. In light of ever-changing technology, the changing requirements of a good Inspector, and an increase in litigation in construction, it is imperative that the Inspector continually strives to learn more about technology, construction means and methods, record keeping, and customer service. It is incumbent on the Agency to provide training in all these areas as well as on the Inspector to take the initiative to continually strive to keep up with the changing face of construction.

The best place for an Inspector to increase the knowledge necessary to keep up with technology, to develop good record keeping habits, and to practice effective customer service is on the job. Inspectors must have a desire to improve and must take the initiative to ask for help and training, work on their own to gain knowledge, and be truly interested in improving.

1-1.4 Inspection Guidelines. Each time Inspectors receive an assignment, they must be prepared to assume a leadership role. They must prepare for the assignment by becoming familiar with the Plans and Specifications, safety requirements, and any special requirements for the Work. The Inspector must also become familiar with the location of the Work and any inherent problems that may be encountered. An effort should be made to contact any local residents or business owners and explain the scope and duration of the Work, as well as any governmental representatives who may have an interest.

During construction, the Inspector is responsible for ensuring that the Work is performed in strict conformance with the Plans and Specifications, agreements for work, applicable laws and safety regulations. The Inspector is responsible for ensuring the safety and convenience of the public while construction is in progress.

INSPECTOR'S GENERAL CHECKLIST. The following is a general checklist to help guide Inspectors in the organization and performance of their duties. (Refer to the detailed Checklists at the end of each major subsection of Part 3)

- A. Review the Plans, Specifications, permits, applicable laws, safety regulations, and applicable codes.**
 - 1. Permits from other agencies:**
 - a. Time restrictions
 - b. Hauling restrictions
 - 2. Special Provisions:**
 - a. Special phasing or sequencing
 - b. Unusual requirements
 - c. Time restrictions
 - d. Hazardous material disposal
 - e. Soil reports and boring data
 - f. Traffic control requirements
 - 3. Notes on the Plans:**
 - a. Limits of construction
 - b. Obstructions
 - c. Removals
 - e. References to Standard Plans
 - 4. Standard Specifications**
 - 5. Reference Specifications**
 - 6. Standard Plans**
 - 7. Safety regulations**
 - 8. Applicable codes**
 - 9. Underground Service Alert (USA)**
 - 10. Traffic Control Handbook (WATCH Manual)**
 - 11. Submittals**
- B. Review the Contract and Construction Schedule.**
 - 1. Notice to Proceed**
 - 2. Working days/Calendar days**
 - 3. Mobilization time**
 - 4. Schedule of values/payment schedule**
 - 5. Bid-listed sub-contractors**
 - 6. Liquidated damages**
- C. Other Information.**
 - 1. Grade sheets**
 - 2. Correspondence**
 - 3. Permits from other agencies**
 - 4. Right of way agreements**
- D. Inspect the Work Site.**
 - 1. Traffic requirements**
 - a. On street parking
 - b. Business access
 - c. Residential access
 - 2. Check lay-down area**
 - 3. Preview photos/video**
 - 4. Utility mark outs**
 - 5. Stock pile areas**
 - 6. Catch basins**

- E. Review Project with Contractor.**
 - 1. Design engineer**
 - 2. Liaison with fire, police, utilities, and other agencies**
 - a. Notifications
 - b. Emergency numbers
 - 4. Permit requirements, if any**
 - 5. Safety**
 - a. Injury and Illness Prevention Plan
 - b. Competent Person
 - 6. Insurance requirements**
 - 7. Project superintendent**
 - 8. Organization**
 - 9. Emergency/after hours contacts**
 - 10. Construction schedule**
 - 11. Payments**
 - 12. Reports required by Owner**
 - 13. Labor requirements**
 - 14. Subcontractors**
 - a. Bid listed subcontractors
 - b. Subcontractor substitutions
 - c. Additional subcontractors
 - 15. Lay-down area**
 - 16. Traffic requirements**
 - 17. Noise restrictions**
 - 18. Work hours**
 - 19. Hazardous materials mitigation plan**
 - 20. Sewer spill mitigation plan**
 - 21. NPDES requirements**
- F. Controls.**
 - 1. Communication**
 - 2. Inspection procedures**
 - 3. Sampling and testing**
 - 4. Safety notifications**
 - 5. Payments**
- G. Records and Reports.**
 - 1. Maintain daily record of construction activities**
 - a. Personnel
 - b. Equipment
 - c. Work completed
 - d. Non-conforming work
 - e. Conversations
 - f. Problems
 - g. Safety incidents
 - h. Site visits by others
 - 2. Record daily project status**
 - a. Work days
 - b. Rain days
 - c. Administrative delays
 - d. Contractor caused delays
 - e. Days in arrears
 - 3. Use photos and/or video when necessary**
 - 4. Maintain clear, concise records**

1-2 INSPECTION POLICY.

1-2.1 General. Inspection of public works construction is a control exercised by the Agency over the materials, methods and workmanship used by the Contractor in the performance of their work. The purpose of inspection is to ensure compliance by verifying that the work is in conformance with the Plans, Specifications and other requirements of the Contract or Permit for public works construction, including compliance with the pertinent provisions of orders, regulations and laws of the Agency and the State and Federal government. It is essential that the Inspector read all of the Contract Documents, and re-read them from time to time to ensure complete familiarity with all provisions and requirements.

Inspectors should neither superintend the work nor prescribe or interfere with the Contractor's methods of performing work. However, if in the opinion of the Inspector, the methods of the Contractor will not meet the requirements of the Contract, the Contractor should be warned similarly, if the Contractor's methods could produce a hazard to life, health or property, or result in defective work which would be impractical to correct or replace subsequently, Inspectors should notify the Contractor to stop the portion of the Work involved and immediately notify their supervisor. The Inspector must cooperate fully with Contractors and assist them in all ways to complete the Work economically, expeditiously and satisfactorily.

1-2.2 Relations with the Contractor. While Inspectors do not generally have the authority to allow deviations from essential Contract or Permit requirements, they must carefully avoid an inflexible attitude with respect to requirements in trivial construction details or technicalities. The Inspector should not interfere with the Contractor's method of performing the Work. The inspector should advise, but not try to force the Contractor to follow a certain procedure where the Specifications permit more than one method. Such interference releases the Contractor in whole or in part from the responsibility he has assumed under the Contract or Permit to obtain specific results. If prompt objection is not made to unsatisfactory work, it will be difficult to prove later that it was not satisfactory.

Orders to the Contractor should be in writing, or later confirmed in writing, so that instructions will be clear and no misunderstanding develop over controversial issues. Particular care should be taken that no instructions are given which could be construed as assuming superintendence of the Work. Poor judgment in this respect could result in claims against the Agency. (See Subsection 1-3.6.)

Instructions or formal orders should be given by the Inspector directly to the Contractor or the Contractor's representative. The Contractor must provide a competent representative who is more than a "pusher." The Contractor's representative must be able to read the Plans and Specifications and perform the necessary layout for the Work and is expected to properly oversee the many phases of the Work. The Contractor is required to direct the activities and operations of the workers in accomplishing the Work.

All of these activities are the Contractor's responsibility and not that of the Inspector.

Relations with Contractors and their employees should be agreeably maintained. Inspectors should enforce their decisions through their personality, and their judgment should be fair and impartial. Inspector's knowledge of the Work and the Plans and Specifications under which it is to be accomplished should be so thorough that they will achieve respect and compliance. Inspectors should not give any directions which are not justified by the Contract Documents, but should insist on compliance with such directions that they do give. A reputation of being slack or easy, though it is quickly attained, is difficult to overcome.

An order suspending any part of the Work betrays a serious condition. Public relations, as well as economic loss, may be involved. Consequently, such orders are never to be given lightly or in a spirit of punishment. However, situations will occasionally occur when orders suspending the Work must be issued. Certainly the Work must be built to line and grade. Dimensions and quality must be as specified, and the finished work must be acceptable within specification tolerances.

1-2.3 Relations with Other Agencies. The closest cooperation should be maintained at all times with all other levels of government with which the Agency conducts business. Any suggestions or criticism of any of the functions or personnel of another governmental unit should not be tendered directly to such unit but should be written and forwarded through the Inspector's supervisor.

1-2.4 The Inspector's Public Image. Inspectors are expected to conduct themselves at all times in such a manner as to reflect credit upon themselves and the Agency they represent. Consumption of alcoholic beverages, gambling, fighting, lotteries, and games of chance, use of narcotics or conduct of similar degree of impropriety during working hours will not be condoned. Violations of this nature are cause for suspension or discharge. Inspectors should be suitably dressed for the work to which they are assigned and, be clean and neat enough to be a suitable representative of the Agency to the Contractor and the public.

Inspectors are expected to be pleasant, courteous and business-like in meeting the public. Above all, their conduct must be governed by common sense. To the public, they represent, the Agency. The people hold them responsible for accomplishing their work in a manner which will afford the greatest public benefit and the least public inconvenience. It is important to be helpful and considerate in answering questions asked by the public, and if the Inspector cannot definitely answer their questions, he/she should try to ascertain the answer or refer them to the proper authority or department for accurate information.

1-2.5

Public Information.

1-2.5.1

General. Information regarding the Work for the general public should be furnished by the Inspector in a manner that reflects the policy of the Agency. Generally, information is restricted to construction details. Inquiries from representatives of the press requesting data for publication and from representatives of Chambers of Commerce and similar groups requesting data for reports to their organizations should be referred by the Inspector to the Agency public relations function.

The Inspector is cautioned not to furnish any information on the following matters:

- (a) Matters pertaining to claims or lawsuits involving the Agency. Such information should only be released only by the legal counsel for the Agency.
- (b) Estimates made by the Agency for future work to be done under the Contract.
- (c) Information as to policies, procedures and official actions of the Agency, and as to property and rights in property to be acquired by the Agency.
- (d) Results of tests of competitive materials and products. The Inspector should not discredit any Contractor, product or manufacturer.

1-2.5.2

Public Speaking. Inspectors should not engage in controversial activities in public, particularly if public speaking, public debate, radio programs, are involved without the prior approval of the head of the Agency management.

1-2.5.3

Writing for Publication. All compositions intended for publication that relate to the business of the Agency should first be approved by the Agency management.

1-2.6

Work Site Communications and Instructions.

1-2.6.1

General. Important communications and instructions should be issued in writing. If a Contractor, permittee or other agency performing work under the jurisdiction of the Agency, fails to comply with or violates any Contract or Permit provision, ordinance or lawful instruction, or causes any unsafe condition, written instructions are mandatory.

1-2.6.2

Verbal Instructions. Appropriate verbal instructions relative to non-compliance, safety violations, etc., should be given at once by the Inspector or Supervisor to the representative of the Contractor or permittee on the Work site. The text of these instructions should be noted by the Inspector in the Job Report.

1-2.6.3

Job Memorandum. The Job Memorandum is intended for the purpose of permitting the Inspector to issue written instructions regarding routine matters, or confirming verbal instructions to a Contractor or permittee where a Notice of Violation or Non-Compliance may be inappropriate, or where the circumstances are not of such importance as to warrant the issuance of the latter form. An example of the use of the Job Memorandum would be to notify the Contractor not to backfill a sewer trench until the Inspector returns from a second job assignment at a specified time to check the make-up of the pipe joints.

1-2.6.4

Notice of Non-Compliance. Verbal instructions regarding non-compliance should be confirmed the same day by a Notice of Non-Compliance, except in those instances where instructions are complied with at once. When this notice is issued to a party on the job who is not the permittee or prime Contractor, the notice should be addressed to both the party on the job and the permittee or prime Contractor.

Inspectors are authorized to issue Notices regarding violations or non-compliance with the Plans, Specifications and legal requirements of the Permit of the Contract, and to stop the Work if the Contractor's methods will cause unsafe conditions or will result in defective work which would be impractical to correct or to replace subsequently, while permitting other (conforming) portions of the Work to continue.

1-3

RECORDS AND REPORTS.

1-3.1

General. Keeping accurate records and reports is a very important function of the Inspector. These records are necessary for a number of reasons. Some of the most common reasons for job records and their use as references are as follows:

- Time and material accountability, including quantities for periodic progress payments and extra work under cost plus change order procedures.
- Verify actions and decisions of the Inspector, Contractor or Design Engineer.
- Establish Work status and site conditions in the event of an accident or liability claim.
- Verify time charges and justify inspection activities to the permittee who questions inspection fees.
- Clarify the continuity of the Work (working days, delays, activities) when the Contract time of completion is in dispute.
- Prepare responses to inquiries and complaints.
- Evidence in legal actions.
- When there is a change of inspection personnel; progress or status of the Work in order to orient the newly assigned personnel.

These uses should be kept in mind and job records should be prepared accordingly.

1-3.2

Job Reporting Procedure. The record of activities on a construction job should be reported in the exact sequence as it takes place.

The basic daily reporting medium, the Construction Inspector's Daily Report (Plate 1 in the Appendix), is commonly referred to as the "Job Log." It is a continuing report on the progress of the Work and provides for the use of as much space as is necessary to adequately report each day's progress and activities. Each day's report begins on the line following the previous day's report and each page is numbered consecutively.

Each daily entry should be brief but at the same time be complete, clear and factual and should include all work accomplished by the Contractor as well as pertinent related information. In other words, the Inspector should think “who did what, where, when, how and how much.” Entries must be made daily to avoid errors or omissions, and must include the number of hours charged against the Permit or Contract and the Inspector’s legible signature. Abbreviations are acceptable as long as their meanings are not confusing and have a common acceptance.

On Permit projects, the Daily Reports are the only continuing job reporting medium utilized, except for the Inspector’s personal diary or notes and “as-built” information recorded on the Plans.

On most large projects, especially those requiring more than one Inspector, the Inspector in charge should keep a daily Job Log compiled from the daily reports assigned to the Permit or Contract.

On Contract projects, the Job Log should include a daily record of all personnel and equipment working on the Work. This information need not be included when a special reporting form is utilized for this purpose.

1-3.3.1

Job Reporting Checklist. The following is a general checklist of entry items applicable to all jobs:

- All entries must be printed in black ink or typed.
- The first report in any series should begin with the job title, job number, Contractor’s (and subcontractor’s on first working day) name, address and phone number; as well as the superintendent or foreman’s name and office phone number.
- Entries should be brief, but should include all work and activities and related information.
- Entries are clear, accurate and legible.
- Total regular inspection hours worked and signature for each daily entry.
- Overtime hours noted by the initials “OT” after the number of hours.
- Entries made the same day the work are performed to avoid errors or omissions.
- For each daily entry, include the pre-printed number of any Job Memorandum or Notice of Non-Compliance issued on the job and underline in red.
- If work being done is Change Order work, record the Change Order number and description of the work as part of the entry on the job report.
- Record any verbal instructions or authority from the Design Engineer on the job report on the day received, including the Design Engineer’s name.

1-3.3.2

Accident Report Filing Procedures. All job related incidents must be noted on the job reports, such as personnel and equipment working, traffic accidents, damage to existing improvements or utilities, personnel and equipment involved, injuries, etc. Report only “facts” that the Inspector is aware of. Do not report hearsay as a fact.

- On permit work, when inspection costs are charged to the permittee, and the Contractor (after requesting inspection) does not show up on the job site, a Job Memorandum should be issued to the permittee and a note accounting for the time charge entered on the job report.
- Job progress must be reported in terms of quantity, distances, stations and weight when appropriate and applicable. Reporting must account for all bid item quantities including when, where and what was constructed by exact limits so as to establish an accurate audit trail.
- Mention important visitors to the Work site and the nature of their business.
- For all types of construction, the following items are to be considered and reported when appropriate:
 - Factors adversely affecting progress of the Work, such as delay in utility work completion, delivery of materials and equipment, unforeseen conditions, strikes, plan changes, poor Contractor management, severe weather and resulting soil conditions, etc.
 - Unsatisfactory work performed by the Contractor and corrective actions proposed or taken.
 - Conditions that may require changes or extra work, or generate controversy or claims. The proposed methods of handling the situations should be described. Any indications that the Contractor intends to file a claim should be reported along with the pertinent job report.
 - Unusual or difficult engineering, construction or traffic problems involved and their solution.
 - Unusual conditions regarding safety and precautionary measures taken with respect to protecting construction workers, the traveling public and abutting property from injury or damage as a result of the construction operations.
 - Right-of-way, public utility and public transportation problems.
 - Quality of the work produced.
 - Provisions for movement of traffic, access to property, detours and signing.
 - Causes of retarded progress and delays. Contract time, percent of work completed and time extensions granted.
 - Unusual material and equipment brought to or removed from the Work site if it is considered to have a significant impact on maintaining satisfactory progress.

- Documentation of actions taken and justification thereof.
- Field sampling, testing and laboratory test results, particularly failures and resolution.
- Developments regarding problems or undesirable conditions discussed in one inspection report should be followed up in a subsequent report indicating final solution or disposition.
- When shutdown periods occur, include the dates of suspension and resumption.
- Observations and conclusions concerning the overall review of construction operations with particular emphasis on the actual construction features.

1-3.4 Surface and Grading Project Reporting.

- Daily reports should be used for all common surface improvements, such as: rough grade, fine grade, curb and gutter, paving and sidewalk.

1-3.4.1 Typical entries for grading should include:

- Limits of slide or alluvial material removed.
- Name of Soils Engineer or Geologist who checked area.
- Methods and equipment used, soil type and lift thickness.
- Size and limits of subdrains placed.
- Limits of fills placed.
- Compaction tests and results reported by the testing agency.
- All failures should be circled in red and be accounted for by a subsequent entry reporting “retest passed” or other resolution.

1-3.4.2 Typical entries for street subgrade should include:

- Limits of rough grade, cuts and compacted fill.
- Limits of rough grade checked, tests by the testing agency and results.
- Base material source, number of samples and test results.
- Limits and thickness of base material placed and compacted.
- Location and results of compaction tests taken on base material. (Failures resolved as indicated in grading, Item 6). See compaction test log, page 23.
- Fine grade checked and approved for paving.

1-3.4.3 Typical entries for curb, gutter, walk and driveways should include:

- Name of subcontractor (if other than the Prime Contractor)
- Station to station limits of forms placed when concrete is not placed the same day.

- Station to station limits of concrete placed, number of cubic yards placed, type of concrete and admixtures if any, and source of the concrete.
- Type and size of curb and gutter.
- Width and thickness of walk; width and thickness of driveways together with the distance from curb face to top of driveway slope.
- Number of concrete test cylinders taken.
- Station locations of blockouts for catch basins, and curb drains.

1-3.4.4

Typical paving entries should include:

- Name of paving subcontractor (if other than the Prime Contractor).
- Source and type of material.
- Method of laying. Thickness, base or surface course and Weight of asphalt paving material laid (or volume of concrete placed), limits such as separate into different bullets station to station and width and area if payment is made on this basis.
- Testing performed, including plant inspection.

1-3.4.5

Sewers and Storm Drain Project Reporting. Storm drain main lines are usually designated by a letter such as Line “B.” Laterals are usually designated by the letter of the main line and a number such as Line “B-1” or “B-2”. A catch basin can be identified by the lateral associated with it. If main lines and laterals are not designated by letter or number, then laterals and catch basins should be located by station.

1-3.5.1

Typical entries for sewers and storm drains should include:

- Station to station limits of removals, excavation, main line pipe laid (including size and the D-load when applicable), bedding, backfill and water densification by jetting or by other consolidation methods, pavement thickness, limits, and type.
- Station of sewer house connections excavated or laid, including backfill and jetting or other operations performed. Include numbers of any house connection change reports.
- Manholes or other structures completed (or partially completed) including backfill and backfill densification.
- Limits of all special compaction completed.
- When curved sewer lines have been balled, make note on Job Report and underline in red.
- Any sampling and field tests performed as well as the test results reported.
- When lines have been air pressure tested, make note on Job Report and underline in red.
- Location of concrete collars (storm drains), concrete blankets (sewers), concrete supports (sewers, storm drains), and sewer rehabilitation reports.

1-3.6

Street Lighting and Traffic Signal. Daily progress of construction should be recorded on the job reports similar to other phases of construction. Removals, limits of conduit laid, backfilled or “jacked,” cable pulled, pull boxes set, concrete for bases placed, equipment installed, and directional drilling, should be recorded.

Other items that must be reported include:

- When working on existing circuits, record any street-light “safety clearances” obtained with date, time, duration and reason for clearance.
- For equipment and material entries include types and other descriptive information such as manufacturer and model number.
- All receipts for salvage equipment should be recorded on job report.
- When traffic signal shut-down takes place, record location, date, time, duration and substitute traffic control utilized during shut-down.
- Refer to Subsection 3-9.10 for supplemental information regarding street light reports.

1-3.7

Contract Time. Typically, the specified Contract time for Agency projects is specified in working days.

The Standard Specifications include provisions for the assessment of liquidated damages if the Contractor fails to complete the work within the Contract Time. The amount of liquidated damages is typically specified in the Special Provisions. Therefore, the accuracy and substantiation of work progress and delays must be thoroughly and accurately documented. Records, reports and communications with the Contractor during the course of construction are of the utmost importance in accomplishing the enforcement of the Contract in this regard.

From the information reported by the Inspector the Contractor is apprised of the number of days charged and days remaining on the Contract by means of a form entitled “Recapitulation of Contract Time” (Appendix, Plate 7).

After notification of award of a Contract and prior to start of any work, the Contractor submits their proposed construction progress schedule to the Agency. The schedule, in the form of a tabulation, chart or graph (or critical path diagram, when required) must be in sufficient detail to show the chronological relationship of all activities of the project including the start and completion of various activities and the procurement of materials. The construction schedule must reflect the completion of all work under the Contract within the specified time. If Contractors wish to make a major change in their operations after beginning construction, they must submit a revised construction schedule in advance of beginning the revised operations.

As soon as it becomes evident that the progress will not be sufficient to complete the Work as scheduled and within the Contract Time, the Inspector must initiate written correspondence to the Contractor to advising of this likelihood and urging the Contractor to expedite the Work.

Written correspondence should follow in progressive steps, i.e. utilizing field correspondence first (Job Memorandum, Notice of Non-Compliance); and if necessary, the contract administrator or project manager should prepare a letter draft for issuance by Agency management. The ultimate action by Agency management is to recommend that the Contractor be declared in default of the Contract.

1-3.8 Progress Payment Reporting.

1-3.8.1 General. Monthly progress payments are made to the Contractor. The quantities of work accomplished are estimated and reported monthly by the Inspector on a progress payment estimate form (Appendix, Plate 8) which the Inspector submits for approval by Agency management. A common closing date for this report is the fifteenth of each month (or a different date when requested by the Contractor), in accordance with the limitations indicated in Appendix, Plate 8.

1-3.8.2 Extra Work. Extra Work is work for which a Contract Unit Price or Stipulated Unit Price has not been established. The cost of Extra Work, for which unit prices or stipulated prices cannot be applied, is usually negotiated. When a negotiated agreement cannot be reached, the work is done under “time and materials” change order procedures established by the Standard Specifications. It is imperative that complete and accurate records be maintained to substantiate the labor, material and equipment used on the Extra Work. To facilitate accuracy and agreement with the Contractor, the following detailed procedure has been established for such work:

1-3.8.2.1 Procedure for Extra Work (Cost Plus) Change Orders. Unless otherwise specified in the Contract Documents, the following accounting procedure may be used whenever a change order for Extra Work requires that the cost of such work be based on the accumulation of costs as provided for by the provisions of the Standard Specifications.

The Inspector prepares a “Daily Report for Cost Plus Changes,” in triplicate, for each day that work is performed and chargeable to the change order. The form “Daily Report/Invoice for Cost Plus Changes” is utilized for this purpose by checking the box “Daily Report” (examples shown in the Appendix, Plate 66). Daily reports must be numbered consecutively in the upper right hand corner and the last report shall include the word “Final.” The daily report must account only for the time and quantities of labor, equipment and materials used. At the close of each working day, the Inspector reviews the daily report entries with the Contractor’s Representative, obtains the representative’s signature and signs the document. In the event that a disagreement develops regarding an item, either the Inspector or the Contractor’s representative establishes a record of the disagreement by entering appropriate notes on the form prior to signing the document. Any disagreements noted on the daily report must be resolved with the Contractor prior to submittal of the invoice.

Distribution of the “Daily Report”

Original—Supervisor

cc: Contractor’s Representative

cc: Job Envelope or File

The Contractor must utilize the Agency’s form for cost plus changes (example shown in the Appendix, Plate 67). The invoice for cost plus changes submitted should state the cost for each item agreed to and listed on the “Daily Reports.” After verification, the Inspector must prepare a Change Order for the Extra Work done. In the administration and control of Extra Work change orders, the Inspector must be alert and accurate to the extent of those charges which are necessary to complete the change order work.

The following should be observed by the Inspector engaged in cost plus change order work:

- Thoroughly understand what the change order requires. If the limits of the work are not clearly defined, understood, or are inaccurate, accounting cannot be made.
- When the construction operations for Contract work and the cost plus change order work are being pursued at the same time and are closely associated or integrated with other work, special care must be exercised in accounting for the charges against the change order.
- Be thoroughly acquainted with the provisions of the Standard Specification pertaining to the cost of such work.
- Be prompt in recognizing and resolving any situations involving unnecessary or inefficient use of labor, equipment or material.
- The daily report must be fully descriptive. Labor must be accounted for by trade, name, classification and specialty when applicable. Equipment must be identified by specific type, model, size and accessories when differences in these specifications will affect the rental rate. (See the following guidelines). It must also be clearly indicated as to whether the equipment is rented bare (in which case the operator would be listed under labor) or operated and maintained. Description of material items must be specific with units and quantities clearly indicated. For example, the class must be shown for concrete and asphalt base materials, must be listed by type. Miscellaneous items of work may be involved (such as dump charges) which should be accounted for on the daily report by number of loads and dump location with dump fee receipts attached to the report.
- Report daily construction activity on the cost plus change order work in the job log.

1-3.8.2.2 Cost Plus Change Order Guidelines For Listing Equipment

Air Compressor. All types rated in accordance with the manufacturer's rated capacity in cubic meters (cubic feet) per minute at 690 kPa (100 pounds per square inch) gage pressure. Indicate hose length over 15m (50 feet).

Pavement Breakers. Rated by tool weight in kg (pounds) (other air tools not rated by weight).

Asphalt Paving Machines. Rated by manufacturer and model, includes all attachments and accessories.

Road Brooms. Towed rental rates by broom widths. Street-sweeper type, self-propelled, rated in accordance with the hopper capacity in m³ or cubic yards.

Compactors (Impact and Vibratory Types). Hand-guided, gasoline powered, including all attachments and accessories. Rated by load weight or vibratory impact weight.

Light Plants and Generators. Rated in accordance with the manufacturer's continuous rating in kilowatts.

Barricades (Lighted and Unlighted), Delineators. Includes all servicing. Rate per unit per day. (List types).

Loaders, Crawler. Includes all attachments and accessories except for clam action buckets and auxiliary backhoe units. Rated by manufacturer and model.

Loaders, Rubber Tired. Same as crawler type.

Motor Graders. Rated by manufacturer and model.

Pumping Units. Manufacturer's rated capacity.

Rollers, Tamping and Grid. Rated by number of drums and drum dimensions (diameter and length), rated by size and weight.

Rollers, Street (All Types). Rated by manufacturer and model.

Rollers, Vibratory (Towed and Hand Guided). Rated in accordance with type and power rating of the engine mounted on the roller.

Rollers, Vibratory (Self-Propelled Types). Rated by manufacturer and model.

Saws, Concrete Cutting. Rated by the net engine horsepower of the gasoline engine. Indicate length and depth of cut.

Hydraulic Cranes and Excavators (All Types). Rated by manufacturer and model. Includes all attachments and accessories.

Shovels, Power Crawler or Truck Mounted. Rated by manufacturer, model type and use (shovel, backhoe, driving piles with leads, crane, clamshell, and dragline or for driving piles without leads).

Tractors, Crawler. Listed by manufacturer and model. Includes all attachments and accessories such as power control units and push blocks (when needed) but does not include bulldozer and ripper units. Indicate accessories used.

Tractors, Rubber Tired Small Industrial and Farm Types. Rated by manufacturer and model. Indicate accessories such as loader, bulldozer, and backhoe.

Tractors, Rubber Tired, Heavy Construction Type. Same as crawler tractors.

Trenching Machines. Rated by manufacturer and model. Includes all attachments and accessories.

Dump Trucks (On Highway Type). Rated in accordance with the total number of axles in the vehicle train. Includes all end-dump, side-dump and bottom-dump, including all attachments and accessories.

Welding Machines, Arc. Rated by manufacturer's output rating expressed in amperes. Includes all attachments, accessories, helmets, rod holders and cable. (Diesel, gasoline or electric powered).

1-3.8.3

Cost Breakdown, Lump Sum Bids or Bid Items. In order to provide a measure of uniformity in estimating progress payment amounts, the following guidelines are furnished. These values (expressed in percent) can be used by the Inspector in reviewing cost breakdowns of lump sum projects or lump sum bid items.

Public Works Inspectors' Manual

PIPELINE CONSTRUCTION			PERCENTAGE	
Open Cut (Trenching)	Storm Drain	Excavation and pipe laying	80*	
		Backfill and jet (or mech. Comp.)	10	
		Perm. Resurfacing and cleanup	10	
*Where total project is lump sum, reduce this item by 10% to provide for structures and other work				
	Sewer (Unlined Pipe)	Excavation and pipe laying	80	
		Backfill and jet	10	
		Perm. resurfacing and cleanup	10	
	Sewer (Lined Pipe)	Excavation and pipe laying	75	
		Joint make-up and liner plate welding	10	
		Backfill and jet	5	
		Perm. resurfacing and cleanup	10	
Tunnel	Storm Drain	Tunnel excavation	50	
		Shafts	10	
		Pipe laying	20	
		Concrete and earth backfill	15	
		Resurfacing and cleanup	5	
			Unlined	Lined
	Sewer	Tunnel Excavation	50	50
		Shafts	10	10
		Pipe laying	20	25
		Liner plate welding	-	5
		Concrete and earth backfill	15	5
		Resurfacing and cleanup	5	5
PAVEMENT CONSTRUCTION				
Pavement	Asphalt Concrete	Subgrade for select material base	20**	
		Select material base	Per m ² (sq.ft.)	
		Asphalt concrete	Per Tonne (ton)	
	Concrete	Subgrade for select material base	20**	
		Select material base	Per m ² (sq.ft.)	
		Concrete	Per m ² (sq.ft.)	
		**To pay for subgrade for SMB, use 20% of the price per m ² (sq.ft.) for SMB.		
STREET LIGHTING CONSTRUCTION (LUMP SUM CONTRACTS)				
Street Lighting	Removal and relocations***			
		Service points	5	
		Underground work	35	
		Bases	5	
		Conductors installed	10	
		Electroliers erected and connected	35	
		Resurfacing, caps and cleanup	10	
		***Estimate the percentage for this item and reduce all other items to compensate.		

There will be instances where the nature or complexity of a particular project will result in the need to modify these values to more properly reflect appropriate payment to the Contractor.

1-4 SAFETY AND CONVENIENCE.

1-4.1 General. A primary responsibility of the Inspector is to have a working knowledge of the controlling regulations, codes and directives dealing with public convenience, public safety and construction safety. Inspectors must have the ability to apply this knowledge to the Contract or Permit construction to which they are assigned. In the area of safety, there can be no hesitation on the part of the Inspector to take immediate action to reduce or eliminate a hazard or an unsafe practice. Inspectors must make a conscientious and diligent effort to eliminate any conditions which, in their judgment, would be hazardous to the workers, the public or to themselves.

It is the responsibility of the Inspector to follow safe-practice rules, render every possible aid to the Contractor in providing safe operations, and report all unsafe conditions or practices to the proper authority. The Contractor's Representative must insist on employees observing and obeying every rule, regulation and order as is necessary for the safe conduct of the Work, and take such action as is necessary to obtain compliance.

In 1970 Congress passed the Williams-Steiger Occupational Safety and Health Act which resulted in the creation of the Occupational Safety and Health Administration (OSHA) within the Department of Labor. OSHA safety rules and regulations take precedence over any less stringent, conflicting, or overlapping State or local safety regulations.

Federal law provides for enforcement agreements with individual states that adopt regulations as effective as the OSHA regulations and have a safety enforcement organization. Federal OSHA protects the Contractors' employees and the general public but not public employees. State Plans, like Cal/OSHA protect public employees also.

Most of the 50 states have entered into agreements with the Federal government which permit local state enforcement.

Although the matter of safety at the Work site is the Contractor's legal responsibility, the Inspector may well encourage safe working practices by pointing out possible sources of danger. The Inspector must be safety-conscious and not hesitate to promote safe practices.

If, in the informed opinion of the Inspector, the precautions taken by the Contractor are found to be insufficient or inadequate in providing job or public safety at any time during the life of the Contract, the Inspector must inform the Contractor to take additional precautions. If the Contractor fails to take action on safety violations, after being advised of the unsafe condition, it is the duty of the Inspector to notify Agency management in order that the enforcing OSHA agency may be notified.

The Inspector can demonstrate interest in safety by establishing a firm, positive attitude toward the prevention of accidents. The Inspector's knowledge of the construction safety orders is essential if violations arise. The Contractor is required to submit an IIPP (Injury and Illness Prevention Plan) to the Agency prior to the start of the Work.

1-4.2

Agency Personnel Safety.

1-4.2.1

General. Employees of the Agency at the Work site should be safety conscious at all times and should not work under any conditions that are in apparent violation of the OSHA regulations. It is mandatory that Inspectors conform to all safety regulations. In this regard, the Inspector, as an employee, has the same rights and is afforded the same protection as any other public employee within the State. These are:

- Employees or their representative may call the OSHA enforcing agency and report any unsafe working condition. Employees need not identify themselves. If the employees do identify themselves, their identity is kept confidential.
- An employee may refuse to work under unsafe conditions.
- Any employee has the right to observe, monitor or measure employee exposure to hazards and has the right of access to accurate records of employee exposure to potentially toxic materials or harmful physical agents.
- The employee may not be harassed or disciplined in any way for the legitimate calls reporting unsafe conditions or for refusing to work under unsafe conditions.

1-4.2.2

Safety Rules for Inspectors. The following are general employee responsibilities as prescribed in OSHA law. No person should do any of the following:

- Remove, displace, damage, destroy or carry off any safety device, safeguard, notice or warning, furnished for use in any employment or place of employment.
- Interfere in any way with the use thereof by any person.
- Interfere with the use of any method or process adopted for the protection of any employee, including oneself, in such employment or place of employment.
- Fail or neglect to do every other thing reasonably necessary to protect the life and safety of employees.

Almost all injuries and accidents are caused by someone ignoring safety orders, not following safety practices, taking a chance or failing to correct dangerous conditions. Safety orders only establish standards of work safety. They are the framework in which work can be accomplished safely. The safety of Inspectors depends on their own efforts to be safe. All unsafe acts and work practices must be avoided for the benefit of all concerned. To prevent accidents, the Inspector must have a great desire not to have them. Attitude is the keystone of accident prevention. The individuals with proper attitudes have few accidents, whereas the careless have many. The Inspector must be able to recognize accident hazards and to eliminate them. Rules are just as necessary in working, as they are in competitive sports. Safe practice rules are needed so that every employee can work as a part of the team, without fear of injury.

Public Works Inspectors' Manual

The following set of rules should be complied with in order to prevent accidents and to enforce safe practices:

- Be in good physical condition before starting work, alert and unaffected by illness or lack of rest, which causes fatigue and decreased efficiency. Problems can lead to accidents if your mind isn't on the job.
- If you become ill when at work, report to your supervisor immediately so that you may receive proper medical attention and arrangements for a replacement can be made.
- Wear the right work clothes and shoes for the job. Your clothing should allow freedom of action and should not hang loosely. Wear durable, hard-soled shoes that fit well. Tennis shoes and other inappropriate footwear, shoes with thin or badly worn soles, or loosely fitting shoes are dangerous and should not be worn. Approved safety vests must be worn when high visibility of personnel is advantageous and when in the vicinity of the Work.
- Wear your Agency-issued high impact plastic hard hat with Agency decal on all job sites that are posted or otherwise designated as "hard hat areas." Check periodically for damage to the shell and suspension system.
- Wear safety goggles when near welding operations or near hazardous liquids or other materials which may spatter and impair your vision. Think about what you see, where to look and what to look for.
- Be sure the equipment you are using, or working near, is in safe operating condition, grounded, properly operated and contributes to a safe working atmosphere.
- Wear gloves when working with chemicals, oils, paints or cleaners. Wash thoroughly after handling anything that might be poisonous or injurious, especially before eating. Report and treat all injuries, no matter how small they may seem. Prevent serious infection by receiving first-aid treatment.
- Never act impulsively. Think about what you are going to do before you do it. Consider the hazards and take adequate precautions. Correct any unsafe conditions you can; report all others to your supervisor. Always expect the unexpected.
- Don't attempt to handle more than you can control. Do your work the right way and safe way; taking short cuts is often dangerous. Work at a speed which is known to be safe, watch where you're walking, and never run.
- Use handrails on stairs or on elevated places. Never jump from platforms, scaffolds, loading docks or other elevations.

- If you notice a fire hazard, see that it is corrected. Observe “no smoking” regulations where posted. You should become familiar with the operation and use of the various types of fire extinguishers provided and their locations.
- Always use safe practices and follow instructions. Help make the entire job safe. Watch out for the safety of other workers and help new employees learn safe work practices.
- Be your brother’s keeper. Consider what you do in terms of the hazards it may create for others. Never leave a booby trap for the next person who may come by.
- Obey all traffic regulations while driving vehicles both on and off the job. Be courteous to other motorists. When not driving, be a safe pedestrian. Stay alert and don’t jaywalk.
- The rules of safety you use at work are just as important for you and your family while you are at home. For safety 24 hours a day, teach and practice safety in your own home. Safety is a year ’round job, always in season.
- Don’t enter manholes, underground vaults, chambers, tanks, silos, or other similar places that receive little ventilation, unless it has been determined that it is safe to enter and you have received training in “confined spaces.”
- Plan your work ahead to prevent accidents, and take part in regular accident prevention programs. Preplanning of safety measures to meet known construction activity hazards will prevent accidents and promote efficient and economical construction. By utilizing proper attitude, basic skill, good habits, thorough knowledge, fair judgment, along with mental and physical fitness, the benefits derived will be worth the effort involved and in the final analysis will prove that safety makes sense.

The cooperation of Public Work is necessary for the inspector’s own protection and the protection of others. It is important that they follow all safety rules, take no unnecessary chances, use all safeguards and safety equipment provided and make safety part of their job. Inspectors must do their part by giving full support to all safety rules.

1-4.2.3

Inspector’s Protective Equipment. Inspectors are expected to wear suitable clothing and protective gear to meet the needs of their employment. For their own protection, Inspectors must wear the hard hat issued by the Agency at all construction jobs where they are subjected to the hazard of falling and flying material. This will also serve to identify the Inspector and set a good example for other people working on the Contract.

Approved protective vests must be worn for high visibility when the Inspector is in close proximity to traffic or moving equipment. It is better to be seen by a vehicle than to be hit by one.

It is particularly important that the Inspector ensure that closed or confined spaces (such as tunnels, pipelines, tanks, manholes and other underground structures) are safe before entering or allowing others to enter. Most Agencies provide portable equipment for the detection of oxygen deficiency, lower explosive limit and for toxic concentrations of methane, hydrogen sulfide and other chemical substances. It is essential that the Inspector learns when and how to use such equipment. If it is not readily available from the Agency, the Inspector should contact the local fire department for assistance (See Subsection 1-5.3.4).

In the demolition of existing structures or facilities, as well as with new construction in an open area, toxic waste materials may be encountered. Inspectors should immediately request professional investigation of the site if they suspect chemical contamination, uncover strange odors, discover asbestos-like materials or encounter any other condition that they consider potentially hazardous.

1-4.3

Work Site Safety.

1-4.3.1

General. The enforcement of regulations for the protection and safety of construction workers is the responsibility of the Federal or State agency delegated by law to enforce occupational safety and health rules.

Employees of the Agency are cautioned that their participation in a Contractor's safety program is to assist in the recognition of safe and unsafe practices. As a general rule, the Contractor alone is responsible for Work site safety and Agency employees are to avoid giving instructions to the Contractor that might be construed as directing the Work.

Contractors may delegate responsibility for safety for their employees and the public to a superintendent, foreman or leadman. These appointees should have sufficient knowledge and experience to be aware of hazards in and surrounding the Work area. Under the law Inspectors are considered to be "competent persons" and can be held personally liable for failing to identify and correct hazardous conditions.

The law defines a "competent person" as one who is capable of identifying predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees or the public. A competent person has the authority to take prompt corrective action to eliminate any hazardous conditions.

If Inspectors permit all of the Contractor's supervisory personnel to be absent from the Work site at the same time, they risk the unintentional assumption of being the competent person until the supervisory personnel return.

1-4.3.2 Construction Safety Enforcement. The following general instructions are intended to provide guidelines to inspection personnel:

1. All inspection personnel, on projects administered by the Agency, must make a conscientious and diligent effort to eliminate any conditions which, in their opinion, appear to be hazardous to the Contractor's employees, the public or themselves.
2. Construction project safety is governed by the pertinent requirements of the various OSHA agency publications as they apply, including the: Construction Safety Orders, Electrical Safety Orders, General Industrial Safety Orders and Tunnel Safety Orders; and special requirements as specified in the Contract Documents and Agency policy such as the *Work Area Traffic Control Handbook*.
3. At the preconstruction meeting, the Inspector should discuss safety with the Contractor to establish the interests and concerns of the Agency.
4. The Inspector must have a timely discussion with the Contractor regarding safety problems which can be anticipated during construction.
5. Any conditions, practice or act which develops during construction, which in the Inspector's judgment is a potential hazard, must be called to the Contractor's attention at once.
6. Any unsafe condition, practice or act should be clearly identified; if the Contractor responds promptly and the resulting condition appears to be safe, no further action is required.
7. When the Contractor fails to take satisfactory corrective action promptly, the Inspector should issue a Notice of Non-Compliance to the Contractor and should request OSHA to make an investigation. The Notice of Non-Compliance should state that the unsafe work area must be vacated and the unsafe condition corrected. If the Contractor fails to remove the employees from the unsafe work area, the Inspector should consult a supervisor about notifying OSHA. If the supervisor cannot be reached immediately, the Inspector may make the decision to notify OSHA.

The Notice of Non-Compliance should contain the following information:

- Description and location of unsafe work area to be vacated.
 - Nature of the unsafe condition.
 - Section number of the Safety Orders violated.
 - When verbal and written warnings were issued and to whom.
 - Date and time Notice of Non-Compliance was issued and to whom.
- (8) Every request for investigation should be noted in the job record, including the:
- Time of call;
 - Name of OSHA authority representative contacted;
 - Name of OSHA authority field investigator, the hour and date of their arrival on the job and a summary of their report.
- (9) Judgment should be exercised to avoid unnecessary involvement of OSHA in minor violations which have little urgency. Inspectors should consult with their supervisor when there is doubt regarding the action to be taken.
- (10) Deaths and serious injuries on the project, either to the public or the Contractor's employees, should be reported to the Agency headquarters by phone and a "Job Safety Record Accident Report" (See Plate 6, Appendix) and forward to the Agency headquarters as soon as possible.

1-4.3.3

Excavations and Trenches. In order to prevent deaths and injuries from cave-ins, the Inspector should confirm that the Contractor is familiar with the required safety standards and shoring methods to prevent cave-ins and has taken all necessary precautions to protect the workers. The protection of workers must be judged at least as effective as that provided for by the Construction Safety Orders.

Many states, such as California, have laws providing that all employers must have Division of Occupational Safety and Health permits to make excavations or trenches 1.5m (5 feet) or deeper.

Excavations or trenching 1.5m (5 feet) or deeper, also require that detailed plans of trench shoring systems be submitted by the Contractor for Agency review.

Sloping the sides of trenches to avoid the need for shoring depends upon the soil type. The maximum allowable slopes (horizontal distance to vertical depth H/V) are:

Stable Rock	Vertical 90°
Type A Soil* ¾:1	53°
Type B Soil 1:1	45°
Type C Soil 1-½:1	34°

*A short-term maximum allowable slope of ½:1 is permitted for excavations in Type A soil that are 3.6m (12 feet) or less in depth and will be open less than 24 hours.

There are a number of excavation configurations, including: benching, combinations of benching and sloping, trenching-shoring-sloping, etc. Consult the *Construction Standards for Excavations* promulgated by OSHA for minimum standards required. All shoring systems, including trench shields and boxes, must now be designed by a registered civil or structural engineer.

The soil classifications described by OSHA for use in connection with excavations are:

- Type A.** Clay, silty clay, sandy clay, clay loam and cemented soils such as caliche and hardpan. It is not Type A if it is fissured, subject to vibration, is layered, or has been previously disturbed.
- Type B.** Granular, cohesionless soil such as angular gravel similar to crushed rock, silt, loam, sandy loam, silty clay loam, sandy clay loam, fissured Type A soil and unstable dry rock strata.
- Type C.** Granular soils such as: gravel, sand, loamy sand, submerged soil or from which water is seeping, and submerged unstable rock.

The selection of a protective system for excavations is shown in Appendix, Plate 55.

For projects requiring a Division of Occupational Safety and Health permit for excavations or trenches, the Contractor is required to designate a “competent person” to make daily inspections of the excavations, adjacent areas, and the shoring systems for evidence of possible cave-in, failure of the shoring, hazardous atmospheres, or other hazards. A “Competent Person/Trench Excavation Certification Form” (see Appendix, Plate 70) must be completed. The top portion of the form above the dashed line must be filled out by the Inspector. The remainder of the form must be filled out and signed by both the Contractor’s Representative and the competent person before the end of the first day of work and prior to any workers entering the trench or excavation.

1-4.3.4

Tunnels, Pipelines and Confined Spaces. Hazardous conditions may exist or be created in a variety of situations when work is performed in confined spaces. The Inspector should be able to recognize these situations in order to ensure that the Contractor takes the necessary safety precautions.

The first safety consideration in tunnel construction is protection from moving ground. Tunnel construction done under contract to the Agency requires approval of the Contractors’ proposed shoring plans by the Agency.

It is the Inspector's duty to enforce strict conformance with all the requirements of these approved plans. As tunnel construction progresses, mechanical ventilation must be provided in order to provide sufficient clean air and avoid the accumulation of toxic gasses. A means of quick communication with personnel outside the tunnel is vital to the protection of personnel.

"Confined spaces," as defined by the OSHA Construction Safety Orders, includes the interior of storm drains, sewers, utility pipelines, manholes and any other such structure that is similarly surrounded by confining surfaces which could permit the accumulation of dangerous gases or vapors. Most of the safe practice provisions for tunnel construction also apply to confined spaces.

A "permit-required confined space" is defined in the General Industry Safety Orders as having one or more of the following hazards: (1) atmospheric; (2) engulfment; (3) entrapment configuration; or (4) other recognized hazard. A host employer, including the Agency, must notify the Contractor of the existence of permit-confined spaces. All existing sewer facilities must be considered permit-required confined spaces, and the Contractor is required to implement a "permit space program" prior to performing any such work. Other types of permit-required confined spaces must be as identified in the Specifications. For detailed information, refer to the General Industry Safety Orders.

Tests for the presence of hazardous gases and oxygen deficiency must be performed with an approved sensing device immediately prior to a worker entering a confined space, and continuously while the worker is inside to ensure a safe atmosphere. Although this is primarily the Contractor's responsibility, the Agency must provide such testing devices for use by its own personnel. In general, the Agency equipment should be used on all projects as a back-up system, to check the accuracy of the test equipment supplied by the Contractor.

Sources of ignition, including smoking, should be prohibited in any confined space. If the possibility exists that confined spaces tested and found not to be hazardous may become hazardous as construction proceeds, an approved safety harness with a life line attached should be utilized with at least one worker standing by on the outside, ready to give assistance in case of emergency.

Potentially hazardous confined spaces where inspection work is performed by Agency personnel, such as larger-diameter sewer pipelines, particularly where there is a live sewer atmosphere or plastic liner work, should be checked regularly to detect any deterioration from a safe environment.

1-4.3.5

Explosives. When the nature of the Work requires the Contractor to use explosives, the Contractor must first obtain a permit from the proper authority. A copy of such permit must be kept on the Work site at all times. Such permit usually requires a qualified blasting operator and special blasting inspection from the permit authority.

1-4.3.6 **Accident Reporting.** Inasmuch as accidents and personal injuries may involve complicated litigation in connection with workers' compensation or damage actions, complete and accurate reports are of the utmost importance. The Inspector must file accident reports in accordance with Agency reporting procedures [See Subsection 1-4.3.2].

1-4.3.7 **Work Site Maintenance.** Good housekeeping and sanitary provisions are important to the safety of the worker and the public. The Standard Specifications and Special Provisions or Permit should be referred to for specific requirements.

Contractors are responsible for public and private property which may be endangered by their operations and must take every reasonable precaution to avoid damage.

Throughout all phases of construction, the presence of rubbish and debris must be kept to the absolute minimum and confined to organized disposal and storage areas. In the interest of a safe working environment, materials and equipment must be removed from the Work site as soon as they are no longer needed. Excess excavated material should be removed from the Work site as soon as is practical.

Dust nuisance must be kept to a minimum by cleaning, sweeping and sprinkling with water or other means as necessary. The use of water for sprinkling must be controlled so as not to generate other problems such as mud and slippery conditions.

The Contractor's equipment and construction operations must not contribute excessively to air pollution by discharging smoke, exhaust fumes, dust or other contaminants into the air in such quantities as to exceed the limits legally imposed by any local control authority (such as the local Air Quality Management District). Likewise, excessive noise for protracted periods should be avoided or minimized as much as possible.

Adequate drainage must be maintained at all times. Existing gutters, ditches or other drainage devices must be kept clear of spoil or debris. Blockage of normal drainage should not be permitted, except in case of emergency to protect the Work. The Inspector must ensure that a temporary dam does not create a nuisance or hazard to the public. The Contractor must not drain water or other liquids into an existing sewer line. Storm drains may only be used for such purposes if permitted by the owner and if an NPDES permit is obtained from the local water quality agency.

Sewers through the Work site must not be disrupted. However, if sewer lines are accidentally damaged, the immediate temporary repair must involve the resumption of sewage flow by conveyance in closed conduits.

Construction materials are normally not to be stored in public streets for more than 5 days after unloading unless specifically located within a pre-designated construction area. Care should be exercised in the placement of materials to minimize traffic hazards or damage to existing plants, trees, shrubs or ornamental objects to which the property owner attaches significant value.

Vehicular access to residential driveways must be maintained to the property line, except when necessary for construction activity for short, reasonable periods of time during the day. Safe and adequate pedestrian zones and public transportation stops, as well as reasonable pedestrian crossings of the Work at frequent intervals, are to be maintained by the Contractor. Whenever possible, existing sidewalks are to remain free of obstructions.

1-4.3.8

Hazardous Materials. OSHA requires an employer to have a written Hazard Communication Program at the Work site to ensure that employees are provided with information regarding hazardous materials in the workplace. Whenever employees of different employers are on the same Work site, it is considered a “multi-employer worksite.” Multi-employer worksites are common in the construction industry.

At multi-employer worksites, the General Industry Safety Orders requires that employers all employers sharing the same worker area are informed of the hazardous substances to which their employees may be exposed while performing their work, as well as any suggestions for appropriate protective measures. The Contractor must comply with the following:

- Keep copies of Material Safety Data sheets at the jobsite for hazardous materials used in the work and make them available to the Inspector upon request.
- Comply with all federal, state, and local safety laws, including hazard communication and the use of protective equipment.
- Confine their employees to their activities in their specific job area.

Also, the Contractor must be informed of hazardous materials used by the Agency in the areas in which the Contractor’s employees will be working. If requested, the Agency’s Materials Safety Data Sheet information must be made available to the Contractor.

1-4.3.9

Hazardous Waste. The Contractor is not responsible for the removal and disposal of hazardous material waste encountered at the Work site which is not identified on the Plans or in the Specifications. The following procedure should be followed by the Inspector when any substance suspected to be hazardous is encountered:

- Instruct the Contractor to stop the work in the area of the suspected hazardous material.
- Instruct the Contractor to cordon off the area affected by the suspected hazardous material and secure the area from entry by any unauthorized personnel.
- Inform your Supervisor as soon as possible of the circumstances of the discovery and any action taken.
- Confer with your Supervisor as needed for any further instructions.
- Direct the Contractor to continue construction activities outside the area influenced by the suspected hazardous material as appropriate under the circumstances.

- Monitor, communicate, and document all activities affecting the execution of the Contract associated with the discovery of suspected hazardous material.
- Ensure arrangements for preparation of the hazardous waste manifest and arrangements for the disposal of any hazardous material waste have been made.

The following includes some examples of situations typically encountered during construction that may indicate the presence of hazardous material:

- Any abandoned tank uncovered during excavation or drilling.
- Soil contaminated by surface spills or from leaking above ground or underground storage tanks. Indications of soil contamination include odors, discoloration, and moist areas.
- Contamination caused by previous dumping of hazardous substances.
- Groundwater or surface water contamination from surface spills or leaking above ground or underground storage tanks.
- Buried drums containing hazardous or unknown substances.
- Any unusual odor or smell.
- Polychlorinated biphenyl (PCB) contaminated material from transformers.
- Asbestos materials such as piping, building insulation, old ceiling or floor tile, and roofing materials.
- Railroad ballast which may be contaminated with heavy metals, heavy petroleum hydrocarbons and/or PCB's.

1-4.4

Traffic Safety and Convenience.

1-4.4.1

General. Agency contracts on highways, major and secondary streets nearly always have special traffic control requirements, such as street or lane closures, detours and hours of work. The *Work Area Traffic Control Handbook* (a reference document in many Agency contracts) specifies general requirements and controls. Extracts from this handbook and information on its availability is in the back of this book.

The *Work Area Traffic Control Handbook* sets forth basic principles and standards in order to provide safe and effective work areas and to warn, control, protect and expedite vehicular and pedestrian traffic through the construction project.

The responsibility of safe and proper handling of traffic rests with the Contractor. The Inspector must ensure that the Contractor provides access for traffic as required by the Contract or permit and must direct the Contractor to correct any potentially dangerous situation that exists. If necessary, directions to take action to protect and warn the traveling public should be in writing.

1-4.4.2

Street Closures. Agency management is typically authorized to close residential streets for certain periods, when necessary for construction work, subject to the following common limitations:

- Authority is limited to residential streets normally carrying light vehicular traffic traveling only to residences within the blocks immediately adjacent to the construction area.
- Closure is confined to daylight working hours.
- Closure must be approved by Agency management, after consultation and notification to Utility, Police, Fire and traffic agencies.
- The Contractor has provided for adequate advance notification to all residents affected by the closed area.
- Suitable warning barricades and lights are placed. Refer to the *Work Area Traffic Control Handbook* for guidance in providing a safe and effective work area.

Requests from the Contractor to close or restrict traffic on any major, secondary or other street (including residential streets), subject to through traffic, should be received in writing sufficiently in advance to permit adequate time for investigation and report to Agency. No such closing or restriction of traffic should be permitted prior to approval. The Agency Public Information Officer is commonly responsible for notifying the appropriate elected officials of all street closings by the Agency.

1-4.4.3

Barricades and Striping. The majority of work inspected by the Agency is performed on public streets. Consequently, nearly all work creates some increased degree of hazard to the traveling public; similarly, the imminence of moving vehicles in the streets increases the hazards to the workers and the Inspector on the project. It is imperative that the degree of interference with the normal traffic flow be kept to an absolute minimum and that the Work area be adequately defined with barricades and lights to warn the traveling public and to afford a satisfactory degree of protection to the workers.

The *Work Area Traffic Control Handbook* may be used for guidance when barricades, warning devices or signs are required.

1-4.4.4

Temporary “No Parking.” At the request of the Contractor, the Agency will typically post and remove temporary “No Parking” signs. Such signs must be posted sufficiently in advance of the start of the Work not only to ensure a safe work area, but also to enable the jurisdictional law enforcement agency to tow vehicles, if needed.

1-4.4.5

Traffic Emergency Service. When the Contractor fails or neglects to adequately barricade and light the work area, and does not respond to instructions to correct these conditions, the Inspector must arrange for Agency forces to perform the necessary emergency work and invoice the Contractor for the costs incurred.

1-5

CONSTRUCTION SURVEY STAKING.

1-5.1

General. Unless otherwise specified in the Special Provisions, all construction staking on Agency contracts is provided by the Agency. Construction survey staking services by private engineering firms or licensed surveyors on all permits administered by the Agency must conform in all respects to the quality and practice performed by the Agency. All grade sheets must be prepared on a grade sheet similar to the Agency grade sheet form.

The Contractor is required to notify the Inspector prior to starting work, so that necessary measures may be taken to ensure the preservation of survey monuments and benchmarks. At the beginning of the Work, the Inspector should verify with the Agency surveyors that this has been done.

The Standard Specifications require the Contractor to protect all survey stakes, witness markers, reference points and survey data painted on existing improvements.

Normally, stakes will be set for rough grade, curbs, headers, sewers, storm drains and structures. Stakes may be set on an offset with a station and a corresponding cut or fill to finish grade (or flow line) indicated on a grade sheet. The grade sheet may be issued on a standard form or be a copy of the surveyor's completed field notes. In the case of structures, such as bridges, these stakes may serve as controls for checking the formwork prior to placing concrete. All other stakes will be set to finished grade with the top colored with blue crayon (commonly referred to as "blue tops"). It is the option of the Agency to determine whether grade and line are provided by blue tops by marking the cuts and fills on pavement (or the stakes) or by referring to stakes, drill holes, chisel cuts, etc., on a grade sheet. If Inspectors are present on the Work site when the blue tops are set, they should check all hubs (blue top reference stakes) set by the Contractor before permitting the blue tops to be disturbed. To avoid damage these hubs should be set a minimum of 100 mm (4 inches) below subgrade. Blue tops are not to be driven down for use as a hub or other grade reference for the Contractor due to the extreme possibility of error in setting. Furthermore, the blue color could mistakenly indicate finished grade.

It is never permissible for Contractors to set stakes for the elevations shown on the Plans unless they are or employ, a registered engineer eligible to practice land surveying or a licensed land surveyor. However, Inspectors may set such auxiliary stakes for their own purposes as desired. The Contractor is typically required to set "guineas" (usually small stakes) or intermediate grades and to transfer grades from offset stakes.

1-5.2

Survey Service Requests. Requests for survey service must be made by the Contractor. When the Inspector doubts that the lines or grade conform to the Plans, due to abuse of the reference points, or for any other reason, or that the line or grade does not appear to check, Inspectors may request survey to recheck or to provide additional control points. Care should be exercised to keep these survey requests to a minimum.

1-5.3

Earthwork Stakes. Rough grade stakes should generally be set parallel to and on an offset from the operation being performed. The interval between stakes is typically 15m (50 feet) or less if the Work is less than 150m (500 feet) long. A lath, serving as a witness marker, is typically set adjacent to the stake marked to show identifying stations and offset distances. Along with the stakes and laths, a grade sheet is issued to the Contractor and Inspector containing essential information such as type of stake set, station, offset distance and cut or fill to a specific location on the Plans.

For slopes, where heavy cuts or fill are to be constructed, slope stakes and offset reference stakes are typically furnished to the Contractor together with a rough grade sheet to permit them to utilize heavy equipment to economically approach the final grades to within approximately 30mm (0.10 foot).

Witness marker laths identifying these stakes show the difference in elevation between the slope stake and reference stake; distance between slope stake and reference stake; station of slope stake and reference stake; cut or fill and distance from slope stake to toe of cut or shoulder of fill; and slope ratio.

In addition to the likelihood of these slope stakes being lost during construction and the inaccuracies that develop as the Contractor transfers these grades, another set of stakes and grade sheets are provided for final grading operations. The location and information for these stakes will vary depending on the requirements, such as proximity to final grades, proposed drainage bench and other improvements.

1-5.4

Street Improvement Stakes. After rough grading is accomplished, a survey party will set curb, gutter (or header) stakes and issue grade sheets. Except when specifically noted on the grade sheets, all elevations shown refer to the top of curb (at face) or header. The Contractor sometimes mistakenly uses such elevations for flow line data the Inspector is cautioned to check the grade sheet against the construction to ensure that the grade sheet is being properly interpreted and the Plan requirements are being met. In case of a varying curb face, cuts or fills will be given both to the top of the curb and to the flowline. Stakes for curb construction or for monolithic curb and gutter are always set on a convenient offset (usually 1.5m [5 feet]) for ease of construction. Unless otherwise indicated, the offset distance refers to the top front face (street side) of the curb. A tack in the top surface of the stake is the exact point from which to measure. Intervals between stakes are generally 7.5m (25 feet), but this distance will decrease if the overall length of the work is less than 150m (500 feet) or if the rate of grade is under one-half of one percent. A witness marker lath will be set adjacent to each stake.

The Inspector must ensure that driveway depressions on the curb are not overlooked. The centerline of driveways may not be staked; however, the centerline station will be indicated on the grade sheet and will typically be shown on the Plans.

Flow line elevations will be necessary if concrete gutter is to be placed against existing curb. The survey party may provide these by chisel cutting an inverted "T" or by painting triangle symbols on the curb face. These symbols are usually set at a constant vertical offset above the flow line (usually 75 mm [3 inches]). This dimension above the flow line will be painted on the curb face at suitable intervals.

After the concrete curb and gutter, or gutter only, has been placed and the concrete has set sufficiently to prevent damage to the surface, the flow line should be checked for proper drainage by running water down the gutter.

Subgrade stakes may be set under certain conditions. These are referred to as "red tops" because the tops are colored with red crayon to distinguish them from finish grade stakes which are colored blue. When blue top stakes are already set, the Contractor must calculate the subgrade and set hubs besides the blue tops and far enough below subgrade to prevent them from being disturbed by the subsequent grading operations. These hubs must be checked by the Inspector for accuracy and dimension below blue tops so there will be no question as to their elevation.

When the roadway measures less than 12m (40 feet) in width between curbs, stakes will generally be set only where elevations are shown on the Plans. If the crown section varies between centerline grade changes, additional stakes will be set on the centerline of the roadway.

For roadways whose widths are more than 12m (40 feet) between curbs, stakes will generally be set on the centerline at specified intervals, in addition where elevations are shown.

Stakes for "T" sections on the Plans are not normally set. Necessary stakes along the "T" section are to be set by the Contractor and checked by the Inspector.

In intersections, "blue tops" will be set for all elevations shown on the Plans. After the base courses of asphalt concrete pavement is laid (on streets where surface drainage is critical and pavement thickness is over 100 mm [4 inches]) the fills to finish surface of the surface course may be painted on the base course to indicate the fill to finished grade. If the base course is to be laid in more than one lift, the Inspector may request that fills to finished grade be painted on the surface of each lift. The fill data provided by the Agency surveyors for paving will be at the same intervals and locations stated above for blue tops set for fine grading operations. Fill data required along "T" sections must be set with a string line by the Contractor and verified by the Inspector.

In alleys, rough grade stakes are typically provided on one side of the alley only where the cut or fill is extensive, except in those cases when the grades for the opposite side of the alley are substantially different. Generally these stakes will not be “tacked.”

When the cut or fill is not extensive, or after extensive cut or fill operations, tacked grade stakes or reference points, with a suitable offset, will be provided on both sides of the alley between the property lines at each end of the alley and at specified intervals, depending on the alley length and flatness of grade. A grade sheet will be issued indicating the cuts or fills for both top of header grades and the flow line of the longitudinal gutter.

If alley intersections are to be constructed, the curb returns will be staked at the time the stakes for headers are set. If the Work includes the improvement of adjacent streets, the curb returns for alley intersections will be staked along with the adjoining curbs.

When requested by the Contractor, after rough grade has been completed, the Agency surveyors may set blue tops for the longitudinal gutter flow line.

Many street lighting systems are constructed as a portion of the Work to be performed by the Contractor. If this is the case, the electrolier bases are usually located after the curb has been constructed. It is a simple matter and will expedite construction if the Contractor establishes the location of the electroliers (and their stations) by utilizing the curb stakes. The difference in stationing between the electrolier and the nearest curb stake is used to obtain the required measurement between them.

When the street improvements exist, electrolier locations are typically indicated by a “Y” painted on the curb. Where no curbs exist, electrolier stakes are referenced to the proposed curb.

1-5.5

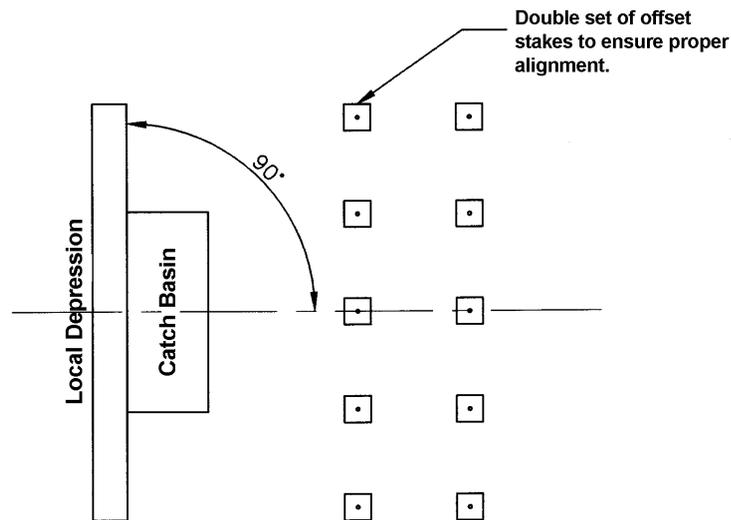
Pipelines, Utilities and Other Substructure Staking. Under normal conditions, mainline sewer and storm drain pipe will be laid from offset stakes. The offset distance will be determined by the Contractor based on the equipment being used; depth of cut, type of soil encountered, and trench width. Line and grade must be transferred from these offset stakes by the Contractor and checked by the Inspector. These stakes will be set at specified intervals, generally 7.5m (25 feet) or less. Generally, at least three consecutive stakes should be used to establish line and grade, either in the trench or on the surface, to detect staking errors prior to laying pipe.

Other offset stakes along the mainline are set at existing joins, BC's and EC's of curves and inlets; and outlets and stubs of manholes or structures. If the manhole stub is not on the sewer line produced, stakes are set 3m (10 feet) or more from the manhole and on the line of the stub. Offset and dimensional stakes are also used to locate other structures such as: lampholes, clean out structures and special structures. A grade sheet is prepared, describing the kind of stakes, offset dimension or line indication, cut to flow line or special elevation, station and other special information.

For large diameter pipe, generally 1.5m (5 feet) and over, sloped excavations, or cast-in-place structures, “blue tops” for line and grade may be used in the trench in addition to the offset stakes which would then be used for excavation only. Blue tops become necessary because of the high risk of inaccuracy in transferring grades from long offset distances. As a rule, stakes for house connections are set 0.3m (1 foot) or more beyond the end of the pipe of the house connection line produced. Offset stakes may be set if the house connection is unusually long or is not on a straight line or straight grade. If a general note on the Plans calls for a uniform depth at property line then the stakes are set only for location. If a special depth is called out for any house connection, then both depth and location will be indicated. This and any other special information will appear on the grade sheet.

Staking for catch basins for storm drain systems is frequently included with the curb stakes. Usually one stake is set on the curb stake line opposite the center of the catch basin. For catch basins over 2.1m (7 feet) long, stakes are also set opposite the ends of the proposed structures. If the curb stake line is too close to permit excavation for this catch basin without losing the stakes, the stakes are set on a larger offset dimension. This will be noted on the marker lath and the grade sheet.

If there is no existing curb and no curb is to be constructed, stakes for small catch basins are set 1.5m (5 feet) back of the future curb on the centerline, and 1.5m (5 feet) or more on each side of the centerline of the catch basin, so that the catch basin may be constructed on line with the future curb. For catch basins over 2.1m (7 feet) long, stakes are set opposite the ends of the structure and the center-line stake. If no stations are shown on the Plans, the stakes will be identified with letters.



A curb may already exist which must be removed for catch basin construction. In this case, drill holes are set in the top surface of the curb at an appropriate distance each side of the center of the catch basin. These points are identified and referenced to the grade sheet by letters. The Inspector should review the appropriate Standard Plans and Project Plans thoroughly. The center stake may locate the center of the basin, the center of the opening or the width depending on which type of basin is to be built.

Typically, when the mainline pipe and the catch basin are already in place, a connector pipe extending from the catch basin to the mainline transition or junction structure which is less than 7.5m (25 feet) in length, is not staked unless the grade is less than 0.5 percent or there is a major line or grade change point required by Plans. Catch basin outlet elevations are determined either from the Plans or the Standard Plans. The Project Plans will also indicate the elevation difference between the mainline and the connector pipe inlet flowlines. The flowlines of connector pipes are typically between a straight grade on their connecting structures.

In most cases, utility companies will use the Contractor's rough grade stakes for any relocation of required services. However, when approved, a separate set of stakes for utility purposes may be set by the Agency before construction begins. This staking generally follows pipeline staking procedures.

A series of offset stakes, with cuts to specified elevations, will be provided to locate the shaft for tunnel operations. Controls to establish line and grade from the shaft into the tunnel may vary depending on the Contractor's excavation methods. One popular system is for the surveyors to drive nails and tins on line into the timber shoring on both sides of the shaft, and above the bottom elevation of the intended crown shoring of the tunnel to be driven. The nails and tins must be out of the way of the Contractor's equipment. Line and grade for initial tunneling operations can be easily transferred into the tunnel by the Contractor using plumb bobs hanging from these controls. As the tunnel is driven, periodic checks will be made by the Agency surveyors and additional reference points established. The kind of points again may vary with the type of equipment and methods used by the Contractor. One system is for the surveyors to drive "spads" (hook type nails) on line in the soffit of the tunnel shoring. This provides a means of hanging a plumb bob and visually producing a line from some point previously set. A cut from the spad to a specified elevation or a nail and tin driven into the tunnel shoring on one side of the proposed pipe at springline are also given. After the tunnel excavation has been completed, the bedding placed (when required), and the pipe is ready to be laid, blue tops must be set by the surveyors.

When jacked casings are to be used in lieu of tunneling, the jacking pits may differ from the tunnel shafts (principally in length) in order to accommodate the jacking equipment, etc. Prior to jacking operations, the equipment and first pipe may be checked by the surveyors to ensure correct alignment. Since the casing will be moving, adequate permanent reference points cannot be set; therefore, periodic checks of the casing alignment must be made by the surveyors to ensure that the required line and grade are being achieved.

1-5.6

Bridges, Buildings and Retaining Walls. Retaining wall and bulkhead stakes are typically set on the upperside and at an offset distance great enough to allow for excavation. The offset distance will refer to a plumb face or other definite plane of the wall or bulkhead that is constant throughout its length. The Inspector must be alert to the calculations that may be needed for necessary checks, such as batter, etc. Stakes are usually set opposite the ends, BC's and EC's, grade changes, angle points, changes of cross section in the wall or bulkhead, and at specified intervals in between. A grade sheet will be prepared, indicating the offset and will usually give two grades from each stake, one for the footing and the other for the top of the wall or bulkhead.

After grading has been completed, the original stakes may be unusable for construction due to the height of the wall or extensive offset distance. In such cases, footing stakes may also be set with offsets and grades to specific locations.

In the construction of major bridges and structures, many of the measurements are beyond the scope of the Inspector to witness and check using hand instruments; in such cases, the Inspector must depend on the Agency surveyor. On some projects, a survey crew may be required on a full time basis; while on others, only periodic services may be required.

Stakes are first set beyond the lines of excavation on the prolongation of the control lines of each abutment, pier or bent, needed during construction. The Contractor should decide on an offset that will be convenient and will not encroach upon their construction activities. After the stakes for construction are set, the Inspector and the Contractor must jointly review and understand which location each offset and cut or fill stake-refers to. If piles are required, the location of the pile line is established and a temporary bench mark is set at each end of the structure at pile cut-off elevation. In some cases, pile stakes may be combined with foundation stakes. Foundation stakes may be set to subgrade if the grade has been made. Pile cut-off elevations may not be marked if it is feasible for the Contractor to use the foundation stakes for this purpose. Temporary benchmarks may be placed at some even elevation above the foundation to facilitate the Contractor's work. If starter walls are to be constructed as part of the foundation, it may be necessary for the surveyors to make a line and grade check of these forms prior to placing concrete.

If starter walls are not utilized, it may be necessary to have a survey crew locate the bottom of the pier or abutment wall prior to forming (or after forms are set up) to check the top and bottom for line and elevation. A convenient elevation marked on the back of the form can be of value to the Contractor and Inspector in setting and checking variable height rebar, embedded items and pour strips. Other items that may be critical should be located and checked by a survey crew prior to placing concrete. These could include bearing plates, expansion joints, grade changes and wall openings. When warranted, the Inspector may request the surveyors to make frequent checks during concrete placement to assure that the forms remain plumb, in line, on grade, and that no shift or displacement is taking place. The walls or other components may be checked again after concrete has been placed to verify that the requirements on the Plans have been met.

Falsework bent lines and temporary bench marks should be staked by the surveyor for the Contractor's use in building the falsework. The Specifications usually require the Contractor to submit detailed working drawings of the falsework for approval. It is known that each joint in the falsework will settle when the concrete is placed, and that there will be a settlement of the bridge due to its own load when the falsework is removed. The falsework and dead load settlement, as well as the design camber must be taken into account to meet the elevations on the Plans when the work is completed. Therefore, elevation checks on the bridge deck forms and girder locations are usually beyond the scope of the Inspector and will require the services of a survey party.

Other controls that may require special survey service are the perimeter formwork, reinforcing steel layout, anchor bolts for railings and other equipment and streetlight locations. After the reinforcing steel is in place, elevations of forms should be read and the necessary adjustments made to meet the required grade and camber. The Inspector must be sure to have the screeds checked to ensure that the finished surface required by the elevations on the Plans will be met. When necessary, grade sheets will typically be issued in the field by the surveyor.

The above outline is a general guide to acquaint the Inspector with the information and checks that may be necessary from the surveyors in staking bridges and other structures. Every project presents unique dimensional checking problems and each solution will depend on the design and existing field conditions. The Inspector, Contractor and surveyor should maintain close communication so that the stakes and information supplied by the surveyor are adequate for the Contractor's construction needs and for verification by the Inspector so that the surveying services are not wasted.

1-6

PRESERVATION OF IMPROVEMENTS AND UTILITIES

1-6.1

General. Most public improvement Contracts are located in developed areas, either business or residential. Such areas always have public and private improvements and utilities which must be considered in the design and construction of the improvement.

Agency contracts provide that Contractors are generally responsible for preserving public and private property and utilities along and adjacent to the roadway insofar as they are endangered by their operations. The Contractor must take proper precautions in performing the Work to avoid damage to property. The Contractor is obligated to repair or rebuild damaged property, or to make good any other damage in an acceptable manner to the affected party.

The Plans should show the type and location of the improvements within and adjacent to the construction area. In addition, the Plans or Specifications will provide for the treatment of such improvements (removal, replacement, relocation). However, the inaccuracy of available underground location records the construction of improvements after the Plans were prepared, or other reasons, may lead to problems not provided for in the Contract.

The Inspector is responsible for assisting the Contractor as much as possible to prevent damage and to further coordinate the expeditious relocation of utilities which the construction operations require. In addition, the Inspector must see that any damage that does occur is properly repaired. One of the first duties of the Inspector assigned to a new project is to walk the job with the Plans and compare actual field conditions with those noted on the Plans, making special notes on the Plans where conflicts exist and where other problem may result in damage to existing improvements during construction. Consultation with the Contractor or Design Engineer to resolve potential problems prior to construction will expedite progress and prevent unnecessary expense and potential litigation at a later date.

Usually after award of the Contract and before any work is done by the Contractor; the Agency conducts a preview inspection of the Contract in considerable detail. The purpose is to ensure that all damage done by the Contractor during construction operations is repaired and to ensure that the Agency, the Contractor and the public are protected from false claims and litigation.

The preview typically consists of a visual (photograph or video) and audio description of the condition of the Work site and adjacent improvements such as walls, sidewalks, driveways, pavement, buildings, fences and landscaping features. Disputes regarding the prior condition of adjacent improvements can usually be resolved by reviewing the video or photographs.

1-6.2

Encroachment and Salvage. Many times privately owned improvements need to be removed or altered because they encroach on the public right-of-way and interfere with the planned improvements. Written notice ahead of construction is given by the Agency to the property owner to remove the encroachment.

As required by the Plans or Specifications, the Inspector should see that the Contractor also gives notice for those encroachments that remain at the time of construction.

1-6.3

Utility Protection and Relocation. The importance of protecting existing service utilities from damage in the construction area cannot be too heavily stressed because of the possible hazard to life and property and disruption of other services should damage occur.

The Agency searches all known substructure records and furnishes location descriptions (usually on the Plans) of all utility substructures (except service connections) which may affect or be affected by the construction work required. Information concerning the removal, relocation, abandonment or installation of new utilities is typically specified in the Special Provisions. After award of the Contract, it is the Contractor's responsibility to call the area Underground Service Alert (USA) who will request the utility owners identified in the Contract Documents to mark or otherwise indicate the location of their facilities (including service connections to private property).

Although the Plans or Specifications may require the Contractor to relocate or reconstruct certain utilities as a portion of the Work, such relocation or reconstruction is usually performed by the owner of the utility at the request of the awarding Agency. Such relocations are ordered when it is known that the existing utility will interfere with construction of the Work. When feasible, the owners responsible for such reconstruction will complete the necessary work before commencement of work by the Contractor.

When utility interferences are considered extensive, a pre-construction meeting is usually scheduled by the Agency prior to the actual start of construction of the Work to plan the necessary coordination of utility protection and relocation during construction. Such meetings are attended by the Contractor and interested subcontractors, the Design Engineer, representatives of utilities with installations within the Work site and the Inspector.

Should any potential hazard exist as a result of accidental damage, the Inspector should immediately instruct the Contractor to evacuate all personnel from the vicinity of the damage and to prevent anybody in the vicinity from entering the hazardous area until emergency crews from the affected utility agency have made necessary repairs and given a clearance that the potential hazard has been eliminated.

After the initial safety precautions have been taken, the Contractor or the Inspector must immediately notify the owner of the damaged utility.

There is almost no limit to the variety of utility interferences which are likely to occur during construction, especially in older, heavily developed areas for which records may not exist or are as inaccurate with respect to new improvements as to be practically worthless. It thus behooves both the Contractor and the Inspector to be on the alert and to cooperate with each other to the fullest in order to minimize the great hazard to life and property which can ensue from accidental damage to hidden utility substructures.

1-6.4 Substructure Interference Reporting. Because Work site interferences frequently result in claims for additional compensation by the Contractor or utility owner which are often difficult to resolve and may end in court for final resolution, the accuracy and completeness of the Inspector's job records are of the utmost importance in establishing the facts surrounding the circumstances of the actual damage or extent of any claim. To this end, refer to the special "Interference Report" form in the Appendix, Plate 13.

1-6.5 Protection and Use of Sewers and Storm Drains. All mainline sewers and storm drains will generally be identified on the Plans and their proximity to the proposed improvements will be indicated. The Inspector must ensure that the Contractor takes all reasonable precautions to protect these installations. Any major damage to such mainline installations should be reported immediately to the appropriate maintenance organization so that crews can be dispatched to alleviate any emergency situation which might exist or be imminent. All existing sewer lines (mainline and house connections) must remain in service and if damaged must be maintained by temporary means to permit continued operation until permanent approved repairs can be made.

Unless specifically provided for in the Specifications or the Plans, the Inspector must not permit stormwater or any material other than sewage to be deposited in the existing sewer system. The Contractor must provide adequate desilting of water before it is deposited in the storm drain system.

Catch basins must remain in service during project construction except as provided for in the Contract documents during remodeling or reconstruction phases of the work. It is noted, however, that such reconstruction should not be scheduled during the rainy season or when disruption of existing storm drainage facilities would create a hazardous condition.

1-7

WAIVERS AND DISCLAIMERS.

1-7.1

General. When an Agency furnishes a Contractor a set of Contract Documents, they are generally held in law to have an implied warranty to the effect that the Plans and Specifications are both accurate and suitable for constructing the Work. The accuracy of such warranty refers to the Agency's factual representations about the details and nature of the Work. Should these representations subsequently be proven to be inaccurate or to have been seriously misrepresented, contractors may recover their added costs due to a breach of warranty. An example of such a breach would be depicting deep soil borings on the Plans with no indication of rock substrata, while in actual field conditions, bedrock was encountered at a depth of a few meters or (feet).

Generally, the Agency cannot evade its implied warranty by including boiler plate disclaimers such as a statement that all warranties of the Plans and Specifications are disavowed and thus rendered ineffective should a disparity arise during construction of the Work. Neither will the Agency evade responsibility by including a statement in the Contract Documents that the Contractor must inspect the Work site and examine the Specifications and the Plans to verify their accuracy. Any attempts to convey responsibility for the suitability of the Plans and Specifications to the Contractor are usually disregarded in legal actions. The rationale substantiating this position is that the bidding process would become virtually impossible to conform to, if intelligent contractors could not rely on the accuracy and suitability of the Agency's Contract Documents.

Contractors are aware that some discrepancies and inaccuracies occur in the Plans and Specifications. Inspectors understand that these will be taken care of by interpretation or by change orders at the appropriate time and that if the Contract time or cost is affected, the Agency will make a proper adjustment. However, when obvious or patent defects appear in the Contract Documents, the Contractor cannot recover damages for knowledge which should have been obvious to them at the time they signed the Contract. Both the Contractor and the Agency are held to a standard of reasonable care, and responsibility is imposed on both parties.

This doctrine is based on what intelligent contractors know as well as what they should have known in their field of endeavor.

With respect to a contract clause requiring Contractors to visit the Work site to be familiarized with the site conditions, prudent Contractors would be expected to make a physical inspection of the surface of the site, and from such an inspection and subsurface data available, draw conclusions regarding its impact on their proposed methods of construction. They would not be obligated to undertake an expensive and time-consuming pre-Bid subsurface investigation.

However, there is a doctrine that acts against an Agency that attempts to avoid responsibility by deliberate silence or omission in the Contract Documents. The Agency is obligated to disclose all facts in its possession which could materially affect the Contractor's Bid. Concealment of such facts by the Agency will subject it to liability for any subsequent claims for damages. These damages not only relate to the direct costs such as labor, materials and equipment, but also to other more intangible costs such as delay costs, lost efficiency, cost escalations and extended home office overhead.

1-8

DIFFERING SITE CONDITIONS.

1-8.1

General. Differing or changed site conditions are subsurface or latent physical conditions differing materially from those represented in the contract; or unknown physical conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the type of work being performed.

The Contractor, if prudent, will include a sum of money in the Bid to provide for possible unexpected costs or contingencies which might be encountered. Should no problems arise, this contingency amount becomes a bonus to the Contractor. Specifications attempt to minimize such contingency amounts by providing a "differing site conditions" clause. This is intended to induce Bidders to reduce such contingency costs in their Bids and to depend on the differing site conditions clause to negotiate with the Agency during the construction period when differing or unforeseen difficulties are encountered. In theory, the Contractor is treated in an equitable manner and the Agency receives lower bids over a period of time, having reduced Contractor contingency provisions in its bids.

1-9

PROJECT DELAYS.

1-9.1

General. Delays are generally classified as excusable but non-compensable, excusable and compensable, and inexcusable as well as non-compensable. Excusable but non-compensable delays are provided for in the Specifications, and after negotiation, time extensions are granted without any compensation to the Contractor. Examples of this type of delay include labor disputes, fires, adverse weather conditions, etc., which are beyond the control of the Agency or the Contractor.

Excusable and compensable delays occur when a valid change in the Work is required and an equitable settlement to the Contractor is made in both time extension and cost. Inexcusable and non-compensable delays result from the Contractor's failure to prosecute or properly sequence the Work, or abandonment of the Work. No time extension or compensation is granted by the Agency in such circumstances.

In some instances, Work may be delayed for reasons attributable to both the Agency and the Contractor. This is not referred to as a "concurrent delay," and in such event, the Agency nor is the Contractor entitled to recover damages for the period of delay.

The inherent dependency of the Contractor on such items as weather, labor disputes and availability of materials or equipment, often results in delays in the scheduled progress of the work. Due to the domino or ripple effect on other phases or elements of the Work, serious delays may completely disrupt progress, resulting in inefficiency in deploying labor and equipment. Deviation from the most logical sequence of work may cause the Work to be delayed until unsuitable weather develops, thereby extending a delay period.

In all cases, the Inspector should keep accurate records of the disposition of men and equipment during any delay. They should realistically assess the impact of rain or its effects. Often certain craftsmen (such as electricians) can be moved from outdoor to indoor work without experiencing any delay from wet weather. Conversely, cement finishers cannot work in the rain or for days after a rain until the subgrade is dry and firm. In the latter instance, the Contractor would be expected to remove standing water from forms to expedite preparations for the earliest possible placement of the concrete after a rain.

It should be noted that in some jurisdictions where wet or cold weather is commonly experienced, the Specifications may not recognize such conditions as "adverse weather," and delays from such conditions may not qualify for time extension or compensation.

1-10

SUSPENSION OF THE WORK.

1-10.1

General. The issuance of an order suspending all or part of the Work can have a dramatic effect on the additional costs incurred by the Agency and the Contractor. Such an order must be specific as to whether the entire project is to be suspended or only a clearly defined nonconforming portion of the Work. Suspension of the Work for the convenience of the Agency should be utilized only when no other alternatives are viable or available. Most orders to suspend Work are of an emergency nature involving safety or potentially hazardous situations. However, some orders to suspend the Work emanate from changes found to be necessary in the work or from unforeseen site conditions. The procedure for issuing an order suspending Work is outlined in Subsection 1-2.6.4.

1-10.2

Constructive Suspension of the Work. When the Agency does not issue an affirmative order suspending the work, but the facts indicate that such an order should have been issued, the Contractor may be entitled to an equitable adjustment in time and compensation under the doctrine of constructive suspension of the work.

To establish entitlement, the Contractor must demonstrate that the Agency did something (or failed to do something) to accommodate the forward progress of the Work that a prudent owner, faced with the same issues, would have done in administration of that Contract. The costs to which the Contractor may be entitled include the increased direct and indirect costs caused by the delay, disruption or suspension, but do not include profit.

Failure of the Agency to respond in a timely manner to requests for information or to process shop drawings, can act in such a manner as to delay fabrication and delivery of equipment to the extent that the Work is delayed. This concept can also be reversed when the Contractor fails to submit or resubmit shop drawings in a timely manner.

1-11

CLAIMS AND DISPUTES.

While the Plans and other Contract Documents establish the standards for materials and construction details for the Work, they constitute the Inspector's minimum acceptable requirements to the Agency. On the other hand, these specified materials and details are the most the Contractor has to furnish to comply. This usually results in a narrow range of Contractor performance hovering between what they have to provide and the minimum the Agency will accept. Thus the Contractor and the Agency are automatically placed in an adversarial position at the outset, with the constant potential for dispute.

Such disputes most often arise from ambiguities in the Contract Documents or differing interpretations of Plans or Specifications. While Inspectors have little or no authority to change a Contract Document, or to impose their interpretation as a final decision, Inspectors are responsible for their preparation in order to bring such problems to the attention of those who are responsible to clarify or resolve the matter.

Most disputes are quickly resolved, some by agreement as to the intent, and some by change order when additional cost or time is involved. When agreement cannot be achieved, some disputes result in claims, which if not resolved, can lead to arbitration or litigation.

Therefore, it is essential that disputes be quickly resolved to avoid stoppage of the Work, or other costs to the Contractor. If Contractors are correct in their position, they are entitled to any cost or time extension associated with the dispute. In the interests of the Agency, such costs must be avoided or minimized. When engaging the services of a consultant or construction manager, most large public agencies give considerable attention to the extent of experience professed by the applicants in claims avoidance.

Claims avoidance is best achieved by the Inspector (and the Contractor) planning ahead and looking for problems or conflicts that could arise and result in Contractor delays or disputes. By these means, there is usually time to resolve the problem before the Work reaches the stage that a delay will result.

Of course there will be times when both the Agency and the Contractor cannot reach agreement, and the Contractor will be ordered to proceed (without prejudice) according to the Agency's interpretation, with the Contractor subsequently filing a claim. Contractors will submit documentation to substantiate their claim for additional time and payment for their costs.

It becomes immediately apparent how important the Inspector's records are in documenting the field conditions leading up to the incident that initiated the claim, as well as their records of the labor, materials, duration or other factors involved in the disputed portion of the Work as it progresses.

This should emphasize that complete and accurate inspection records are essential in substantiating (or refuting) Contractor's claims, particularly when the Contractor belatedly files a claim for extra compensation for something that supposedly happened in an earlier phase of the work. Good records and progress photographs (or video coverage) of the Work become useful tools for assisting in resolving most disputes and claims during the course of the Work and are invaluable in the event of subsequent litigation.

1-12

CONSTRUCTION SCHEDULING.

1-12.1

General. One of the cost factors best controlled by the Contractor is the construction time. By their estimate of the extent of the Work and the size of the work force they intend to use, Contractors can arrive at a close approximation of the time required to complete the Work. Since time and labor costs are directly related, Contractors can prepare their Bid accordingly. If Contractors should by good management of time and work force, and by utilizing innovative methods, complete the Work in a shorter period, the resulting cost savings accrue to them, thereby increasing their profit margin. Reducing the time for completing the Work means less interest charges on cash invested during construction, less supervision and overhead expense, earlier availability of equipment for use in other work, and earlier release of funds traditionally retained by the Agency.

All of this emphasizes the importance of developing a realistic schedule to assist in controlling construction time, which is one of the most critical elements of consideration during the bidding process. Prior to World War II, most construction contracts were scheduled using bar charts or similar devices to graphically depict major construction operations. As the size and scope of projects increased, particularly during the war and immediately thereafter, it became obvious that a better system was needed to control the vastly larger projects. Early systems such as the Gantt chart, the Line of Balance (LOB) and Integrated Project Management (IPM) were principally graphic. Procurement and construction projects for the U.S. Navy late in the war resulted in the development of a line and arrow diagram system to depict activity and time relationships. This system was called the Program Evaluation and Review Technique (PERT).

While this system worked well for Navy procurement contracts, improvements were developed in the private sector, principally in the chemical manufacturing industry and the emerging computer industry, evolving into the critical path method of scheduling (CPM). This method of diagram scheduling (called networking) has many attractive features. It can be programmed into a computer to take the drudgery out of processing data or schedule revisions. Also, the CPM can graphically depict the time and cost elements of each activity and subactivity, show the impact of early or late start dates, develop logical sequencing of events, and most importantly, define the critical path.

The critical path is the least time in which a project can be logically completed.

Any factor, such as a delay or the elimination of a portion of the Work, will almost always impact the critical path by shortening or lengthening it. Thus the diagram can be used to accurately estimate the effect of changes in the Work with respect to cost and time.

1-12.2

Initial Schedule Development. The first step the Contractor must take in preparing an estimate cost is to make a time schedule to fit into the project time constraints and set up a tentative plan for doing the Work. This schedule should show all of the items affecting the progress of the Work including the impact that the weather (seasonal) could impose. Such factors as when delivery of critical items can be realistically anticipated; or what physical restraints may be imposed by the contract, for instance keeping major traffic arteries clear near major shopping centers during the holiday shopping season, must be accurately evaluated. From these and other controlling factors, production rates for the major items of work are decided and the number, type and size of the Contractor's plant, labor force and equipment needed to complete the Work within the Contract time, are determined.

From this schedule, Contractors should be aware of the indefinite, hazardous or other features that could affect their cost or time estimates. The Contractor can determine the total man-hours and total machine-hours for major equipment required in doing the Work, peak labor requirements, and delivery dates for important equipment or materials. In addition, the schedule can show Contractors their cash requirements based on scheduled income and expenditures during the Contract period. This is referred to as "cash flow."

1-12.3

Bar Charts. The most common form of scheduling, particularly for smaller projects, is the use of bar charts. They are almost always used, even in larger projects, to initially phase the major elements of the Work to keep them within the Contract time. Since bar charts are graphic, they reflect logical sequencing of work, and indicate the obvious need to accelerate certain items of work, or to adjust lead times for procurement.

Bar charts are best when they are kept relatively simple, reflecting only the major items of work or administrative processing. An example of a bar chart for the construction of a \$300,000 steel-framed warehouse with an overhead crane is shown in Figure 1.

CONTRACT AMT. — \$ 300,000
 CONTRACT TIME — 180 DAYS
 CONTRACT START — 10/1/02

XYZ STEEL FABRICATING CORP.
 Springfield, Ill.
 CHICAGO TRUCK TERMINAL & WAREHOUSE

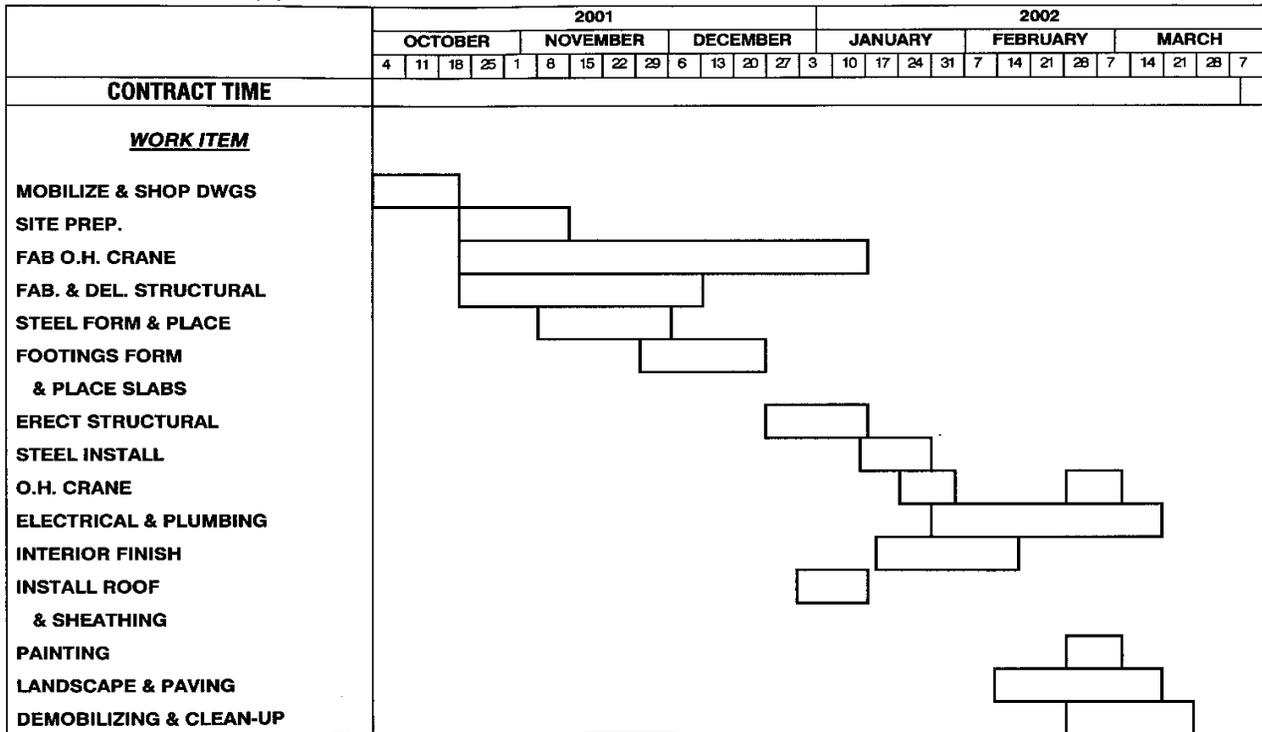


FIG.1 — BAR CHART CONSTRUCTION SCHEDULE FOR WAREHOUSE IN SUBSECTION 1-12.3 OF PUBLIC WORKS INSPECTOR'S MANUAL.

In graphing construction sequencing and showing construction time required for each major item of work, bar charts are of invaluable assistance in developing PERT or CPM diagrams. Even with a CPM schedule available, construction superintendents often use a bar chart in the field to measure and record actual progress against planned progress.

1-12.4

Critical Path Method (CPM). This tool of management is very useful for larger or complicated projects and is required by many governmental agencies on some types of construction. CPM is based upon planning and job analysis that goes far beyond that needed to prepare a Bid for the Work. Besides knowing the detailed breakdown of the Work into its elementary operations and graphing the sequential relationships, the planners must know the duration of each operation, lead time for procurement, shop drawing preparation and approval times, fabricating and delivery times for procured items and methods that the Contractor intends to utilize.

Activities are generally represented on the network by arrows or nodes connected by sequence lines. Analysis may be done manually or by computer for establishing realistic time relationships, selecting these operations whose completion times would be responsible for establishing overall Contract duration, determining the impact of changes and the operations affected (including the effect on Contract duration), establishing realistic sequencing of the Work, and determining the status of work in progress with relation to the number of days ahead or behind schedule.

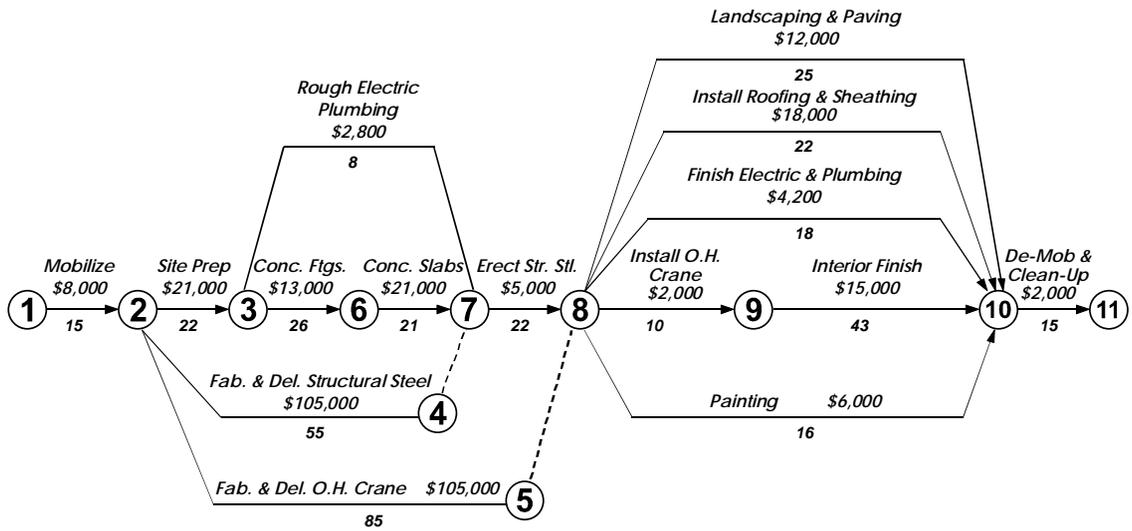


FIG. 2 — TYPICAL CPM DIAGRAM FOR WAREHOUSE IN SUBSECTION 1-12.3 OF PUBLIC WORKS INSPECTOR'S MANUAL

A simple CPM diagram is shown in Figure 2 for the warehouse project described in Subsection 1-12.3. Events are usually designated by circles (referred to as “nodes”) and activities are indicated by arrows connecting two nodes. Activities can be tabulated for computer analysis by using the appropriate node numbers such as: 2-5, “fabricate and deliver overhead crane,” or 7-8, “erect structural steel.” In Figure 2, the time in days is indicated under the arrows and the activity described above the arrows. This diagram has been cost-loaded with the cost of each activity noted above the arrow, the sum of which must equal the contract amount of \$300,000. Cost-loaded networks should be carefully evaluated to prevent the Contractor from front-end loading their progress payments. Note that this diagram shows \$8,000 for mobilization and only \$2,000 for demobilization and clean-up. These figures are sometimes unrealistic because Contractors attempt to put bidding, bond and insurance premium costs in the first few items of work in order to recover their initial expenses and obtain a favorable cash flow. This practice is acceptable provided Contractors use realistic costs for their upfront expenditures. The Inspector should be alert to scrutinize cost-loaded diagrams to discover and disallow unreasonable activity costs designated by the Contractor so as to keep the progress payments more in line with the actual work completed.

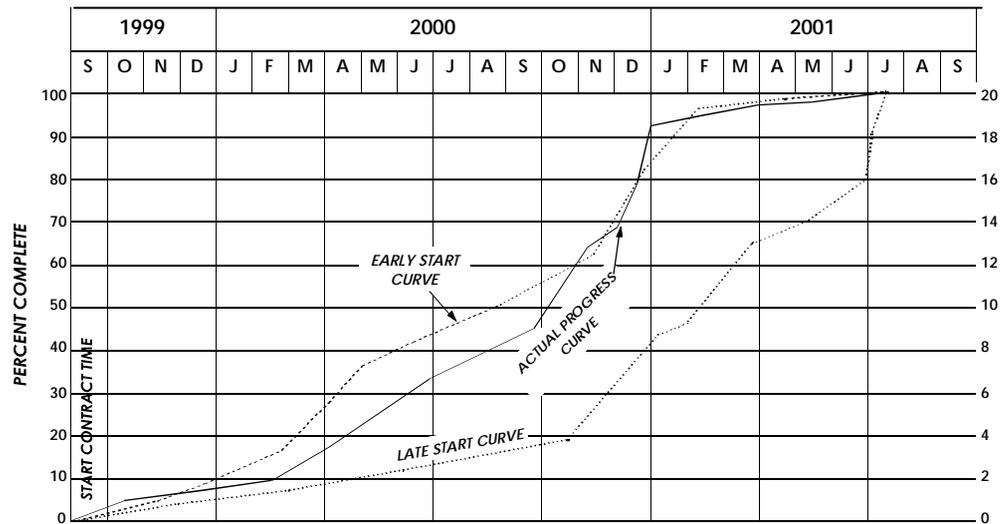
Work items that are performed concurrently often have float time in them. Float is the difference between the time it actually takes to do the item of work and the time in which it must be completed. For example, the rough electrical and plumbing work is indicated in Figure 2 to take 8 days between nodes 3 and 7, yet the placement of concrete footings and slabs between nodes 3 and 7 is estimated to take 47 days.

The difference of 39 days is called float in the electrical and plumbing activity. Similarly, the fabrication of the overhead crane will take 85 days, but the project will not be ready to install it until node 8, 91 days after

mobilization is completed at node 2. The difference of 6 days is float time and the dotted line arrows are called dummy activities which are used to complete the network.

“Free float” is the maximum time of slippage of an activity that can be tolerated without affecting the completion date of any other activity, assuming all activities start at the earliest possible times. “Total float” is the maximum slippage of an activity that can be tolerated without affecting the completion date of the overall project. Each node represents the completion of the preceding activity and the start of the following activity. By the sequence of operations that will require the most time to complete the Work utilizing normal work forces and equipment, the critical path is determined, which establishes the duration of the project. The critical path is indicated by darker (heavier) arrows or by double lines. The critical path is commonly shown on a horizontal line (as in Figure 2), but may be shown on contiguous arrows any place in the network. There is no float on the critical path.

Generally, CPM networks are evaluated to determine early and late starts with respect to each activity and its completion time. The early start dates are the earliest any activity can start, each in its own proper sequence. The late start dates are worked backwards from the specified project completion date and indicate the latest date that each activity can begin and while still completing the project on time. When the cost-loaded activities in the diagram are plotted against contract time and scheduled progress, a set of curves for the early starts and late starts result in a set of curves called the “banana curves” (see Figure 3). These curves are used to predict the cash flow requirements for the Contractor and the Agency, and can be useful in assessing the Contractor’s performance. When the Contractor’s progress is plotted on the banana curves, it becomes obvious whether or not the Contractor’s is meeting the schedule.



**FIG. 3 — EARLY & LATER START CASH FLOW CHART
(Typical “Banana” Chart)**

Should their progress curve fall below the late start curve, it is an indication that the Contractor may be in trouble and may need to accelerate the Work to avoid exceeding the Contract time. A speed-up of the Work would presumably be accomplished only by more outlay for labor and equipment since the cost-loading of the normal network is presumed to be the minimum.

A computer is frequently used to analyze the normal times of each activity on the critical path and compute the maximum time schedule. Then the activity is selected on the critical path which offers the least cost increase in relation to any time decrease, after which a new schedule is computed with the activity "crashed" (taken from the late start date). Under this procedure, the normal start date is considered to be the maximum time. Since these attempts are made to reduce it, the crashed time can represent a substantial reduction of time and produce a new critical path. The computer continues to "buy time" along the latest critical path as cheaply as possible. Once a final schedule has been decided, the Contractor and the Agency are provided with sufficient information to ensure adequate control over time and costs.

CPM schedules must be up-dated (usually monthly) to reflect the Contractor's progress (or lack of it), change order work, delays or any other factors that may impact the schedule. The cost-loaded network, when compared to the Work actually completed, gives the Inspector the best means of measuring progress for payment purposes on large and complex projects.

1-13

CONSTRUCTIVE CHANGES IN THE WORK.

Any conduct by an Agency representative authorized to issue change orders, which is not construed as a formal change order and which requires the Contractor to perform work different from that prescribed by the original terms of the Contract, constitutes a constructive change order. This could entitle the Contractor to equitable compensation and time extension.

For example, a constructive change occurs when it originates from a difference of opinion as to the interpretation of the Specifications or the Plans. An Inspector refuses to issue a formal change order for the work in question because it was, in their opinion, already required under the terms of the Contract. Should the Inspector later prove to be incorrect, the result is a constructive change order.

The responsibility of providing proof that a constructive change has occurred lies with the Contractor. Inspectors must be aware of the consequences of their interpretations of the Contract Documents and must avoid actions which would inadvertently trigger a constructive change.

1-14

CONSTRUCTIVE ACCELERATION.

In the absence of an acceleration order, a constructive acceleration order would exist if (1) the Contractor is entitled to an excusable delay under the Contract Documents, (2) the Contractor has notified the Agency of a delay and requested an extension of time for an excusable delay which is improperly denied by the Agency, (3) the Agency issues an order or implies an acceleration order to meet existing Contract dates, (4) the Contractor notifies the Agency that it considers an informal order to alter the schedule to be a constructive change, and (5) the order to accelerate incurs additional costs related to the constructive change order. It should be emphasized that the Inspector must assess all time delays and ensure valid extensions of time are issued based on the Contract Documents. Failure to do so in a timely manner can result in sizeable acceleration claims presented by the Contractor.

1-15

RISK MANAGEMENT.

The application of risk management procedures should be conducted in strict accordance with Agency policies and guidelines. The following information is not intended to represent legal advice. Risk management identifies potential threats to employee and public safety and health, the environment, and public property and requires that a strategy be developed to avoid or reduce these potential risks. Risk management saves the Agency money by preventing injuries, damage to property, avoiding the cost of delays, and controlling insurance costs. Inspectors must realize that their role in risk management must be proactive. They must try to identify potential risks on the Work site before such risks become accidents or lawsuits. Inspectors are legal representatives of the Agency. When they speak, it is legally the same as if the Agency itself had spoken.

On any construction project, there is a high probability of litigation as a result of the Work. Litigation can be initiated by the Agency, the Contractor, the public, or another agency. There are three potential areas of litigation, contractual, tort, and regulatory enforcement. Contractual and regulatory enforcement litigation is generally the result of an action or inaction by the Contractor or Agency in compliance with laws or the Contract Documents. Tort litigation is based on negligence to compensate for damages caused by the unreasonable conduct of others and may involve personal liability for the Inspector.

In order for negligence to be established, four tests must be satisfied:

- **Duty** - The defendant must have a duty to protect others against unreasonable risks. It is important that the Inspector does not interfere with the Contractor's contractual obligations or become the designated "competent person" on the project.
- **Standard of Care** - The defendant failed to exercise the appropriate standard of care.
- **Proximate Cause** - The defendant's actions are the proximate cause of the damages.
- **Injury, Loss or Damage** - The defendant's actions caused injury, loss or damage to the plaintiff.

The Agency generally represents and defends the Inspector in any lawsuit arising out of the Work; however, this should not deter Inspectors from doing everything in their power within the scope of their duties and responsibilities to be proactive on risk management issues.

1-16 LAND USE ISSUES.

1-16.1 General. Preliminary engineering on public works projects generally involves an investigation of the effect the project will have on biological resources, water resources, cultural heritage resources, and environmental contamination. It is imperative that the Inspector have an awareness of these concerns. Two regulations included in the 1972 Clean Water Act that are especially important to the Inspector are Section 404 and Section 402.

1-16.2 Section 404 Wetlands Regulations - 1972. Wetlands are places where the land and water come together. They provide a habitat for many species and help prevent flooding by holding storm water. Section 404 seeks to ensure that no net loss of wetlands occurs through the discharge of material if a practical, less damaging alternative exists. Section 404 is administered by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency (EPA). A permit from the Corps is required before any work commences in wetland areas. The EPA has “veto” power over any permit issued by the Corps.

The Inspector should be familiar with the provisions of the permit. Any violations of the terms of the permit by the Contractor should be addressed immediately. Inspectors should inform the Contractor, notify their supervisor, and document the situation in their daily log.

1-16.3 Section 402 Storm Water Discharge Regulations - 1990. Storm water discharge associated with any industrial activity such as a public works project must be authorized by a National Pollution Discharge Elimination System (NPDES) permit.

Storm water best management practices (BMP's) include onsite runoff infiltration, vegetation or natural depressions to control flow; dissipation devices; retention/detention structures; stabilization such as seeding, mulching, buffer strips and tree protection; and structural devices such as earth dikes, silt fences, drainage swales, dams, and rock protection.

The Inspector must observe and document that the Contractor's operations conform to the NPDES permit requirements. If there are any violations, Inspectors must inform the Contractor, notify their supervisor, and document the situation in their daily log.