CONSTRUCTION INSPECTION GUIDE
FOR
CONSERVATION PRACTICES

Natural Resources Conservation Service
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Introduction

The purpose of this guide is to aid in the determination of the inspection requirements for conservation practices. It is not possible to specify precisely when onsite inspection is required. Site and soil conditions, size of structure, complexity of practice, weather conditions, type of construction equipment, and the capabilities and experience of contractors all have an effect on the frequency, amount, or extent of on-site inspection required. The most important item is the effectiveness of the inspection provided rather than the amount of time spent on the site by the inspector.

Types of Inspection

Inspection will be one of two types: (1) periodic or (2) continuous. An explanation of these types as related to the installation of conservation practices applied without formal contracts is as follows:

1. Periodic inspection consists of inspection at irregular intervals. It will depend upon the work involved, whether or not the work may be observed later for compliance with the drawings and specifications, and the potential affect on the completed structure a deficiency in construction would have should it go unobserved. On a relatively simple practice, such as a short waterway with a small drainage area, periodic inspection may consist of only performing a construction check after construction is completed. This construction check could consist of the contractor furnishing survey data and notes supporting the fact that the completed construction conforms to standards and specifications. The most critical stage and the item which requires the most attention on practices such as waterways will likely be seeding. Failure of waterways usually results from lack of vegetation establishment.

2. Continuous inspection implies that an inspector is on site from the beginning of construction to completion. However, this should be interpreted to mean that an inspector is available at all times during construction and is actually on site a sufficient amount of time whereby he or she is fully aware of what is occurring, and that the work is in compliance with the drawings and specifications before the succeeding construction operation is performed. Continuous inspection may be required for a specific element or item of work rather than for the entire project or conservation practice. For example, excavation of a cutoff trench may begin at 7:00 a.m. and be the only item of work being accomplished. An inspector could arrive on site toward the end of the time required to excavate the cutoff trench to determine the adequacy of the work. If, through previous discussions with the landowner and contractor, an understanding had been reached as to how and where the excavated material will be placed for later inspection, the operation could be considered one of continuous inspection. Likewise, to have continuous inspection, observation of every rebar being placed is unnecessary if proper inspection of the foundation conditions, proper spacing of the rebars, adequacy of the forms, etc., is observed and deemed acceptable prior to the placing of the concrete.

Items that may be acceptable for periodic inspection and those that typically require continuous inspection are contained in part 512 of the National Engineering Manual.

Inspection Plans

An inspection plan should be considered for installation of every conservation practice. An inspection plan may be as simple as reviewing the drawings and specifications and the responsible person deciding when on-site inspection is required. An inspection plan does not always need to be written. In all cases, the person who determines the inspection requirements must have job approval (for construction) for the specific practice and job class.

On the more complex jobs, a written plan must be prepared. The plan consists of listing times or stages in construction that will require inspection, what the critical items to be observed are, and what, if any, tests are to be taken. The preparation of inspection plans will not only identify potentially critical stages in construction, but can also be useful in scheduling personnel and managing workloads. Written plans must be prepared whenever: (1) the person approving the construction drawings is someone other than the designer, (2) the person performing the inspection is someone other than the designer, or (3) the job is a manure storage structure. An inspection plan will accompany construction drawings and specifications submitted for approval.

In instances where the design is performed by one individual and requires another person's approval, responsibility for determining the inspection requirements and preparing the inspection plan rests with the individual approving the construction drawings and specifications. However, the designer should initiate the plan as the person most familiar with the various design assumptions and parameters.

Construction Inspection as Related to Job Class

Although job class is an indication of the complexity of the design and construction of conservation practices, it does not always accurately indicate the problems or potential risks involved. Site conditions uncommon to an area such as unstable soils in the foundation, soils shallow to bedrock, high water or water table, weak embankment materials, corrosive soils, or construction requiring specialized equipment are factors which affect the complexity of a job but are not specifically related to job class. Not only must designers be alert to these types of conditions, but inspectors must also recognize conditions present on site which differ from those on which the design was based. As a minimum, conditions present on site differing from those anticipated in design must be reported to the individual approving the plans. In other cases, even though job class is not exceeded, consultative assistance may be desirable to assure adequate construction.

Preconstruction Meetings

Having preconstruction meetings between the land user, the contractor, and the inspector will do much to assure quality construction with minimal problems. The need for the meeting will depend upon the complexity of the job, the attitude and understanding of the landowner, and the experience and previous working relationships with the contractor.

It is important to remember that the land user (client) is the decisionmaker for most projects.

The technical agency is supplying a service to the client who, in turn, has hired a contractor. The inspector should not act as an agent for the client in negotiations with the contractor. The contractor has an obligation to the client, not the inspector. With this philosophy in mind, many frustrations and problems may be avoided.

Preconstruction meetings should include a discussion of: (1) the content of the drawings and specifications, (2) stakes to be set by the inspector and what the contractor will place or assist with, (3) inspections to be performed during various stages of constructions, (4) tests required and who is to perform these tests during construction, and (5) safety items applicable to the job.

Items to Inspect

Following are items for various construction operations that should be observed during installations. Some items may not apply for certain practices.

I. Stripping and Foundation Preparation

A. Common items to inspect:

1. Check depth and area of stripping and disposal of materials.
2. Examine foundation materials to determine that they conform to quality assumed for design.
3. Compare the foundation material with description in logs of test borings.
4. Determine that adequate provisions have been made to control water, and that foundation areas are properly dewatered.
5. Ensure that depth of scarification and other foundation preparations are completed.
6. Ensure that oversize rock, logs, and other undesirable materials are removed before compaction.
7. Check that density of earth foundation, after compaction, meets the requirements.
8. Examine subgrade for smoothness, compaction and finished grade.
9. Check that foundation areas are adequately dewatered. Concrete should not be placed on flooded foundations.

B. Examples of deficient items needing correction include:

1. Organic material and topsoil not removed to an adequate depth.
2. Large tree roots remaining in foundation material.
3. Foundation material too soft to adequately support the structure.
4. Foundation too wet for proper construction.
5. Foundation material differing from that anticipated by the designer.

II. Excavations - Earth

A. Common items to inspect:

1. Compare material excavated with logs of test borings.

2. Make sure that suitable materials are used in the work as specified, and that unsuitable materials are placed in designated waste areas.
3. See that adequate drainage is provided as excavation progresses.
4. Determine that operations in borrow pits are as specified.
5. Require that final finish and drainage of borrow areas be as specified.
6. Determine that excavation is to design lines and grades.

B. Examples of deficient items needing correction include:

1. Excavations not to proper line or grade.
2. Spoil material improperly spread.
3. Proper shaping of steep or vertical banks not performed.

III. Embankments and Backfill

A. Common items to inspect:

1. Ensure required excavations are to proper limits and that site is dewatered prior to placing fill materials.
2. Ensure the fill materials are blended properly and placed within the zone limits as specified.
3. Ensure embankment and subgrade is free from frozen material and prevent placing earthfill containing frozen materials.
4. Ensure the lift thickness of backfill prior to compaction is within specified limits.
5. Determine need for wetting, drying, or mixing of fill material to satisfy moisture requirement.
6. Ensure the surface of the foundation or embankment is in proper condition before placing the next lift.
7. Ensure oversize stone, roots, or other objectionable materials are removed from the lift prior to compaction.
8. Determine that structure foundations are compacted uniformly and are to grade.
9. Do not permit backfill around concrete structures until the time limit or minimum strength test of concrete is met.
10. Make sure that the placement and compaction of the backfill around and over structures meets specifications.

B. Examples of deficient items needing correction include:

1. Compacted material not to required lines and/or grade.
2. Frozen material, large rocks, debris, etc., being placed in fill.
3. Compaction less than required by specifications.
4. Fill material either too wet or too dry.
5. Fill material has properties not conforming to what is required.
6. Lifts of fill not blended to avoid laminations.
7. Lifts of fill too thick prior to compaction.

IV. Foundation Preparation Before Concreting

A. Common items to inspect:

1. Ensure the surface for concrete subgrade conforms to the specified location, dimension, and grade.
2. Check the subgrade and any backfill to see that it is properly compacted. In case of over-excavation, see that backfill is made with suitable materials compacted to specified densities.
3. Check that the base material, when required, is of proper gradation and properly placed to prevent segregation.

B. Examples of deficient items needing correction include:

1. Foundation contains soft or spongy material.
2. Foundation has standing water.
3. Foundation not to proper grade or elevation.

V. Forming Prior to Placing Concrete

A. Common items to inspect:

1. Check location, dimensions, and alignments of forms. Check adequacy of foundation to prevent settlement of forms.
2. Be sure forms are smooth and clean on the inside, mortar tight, and free from knot holes and blemishes which may be detrimental to the resulting concrete.
3. Ensure forms are wetted, or oiled with a non-staining form oil. Make sure there is no oil on rebars or in concrete joints and no surplus on forms.
4. Determine that all foreign material such as chips, blocks, sawdust, dried mortar, and dirt are removed, preferably by air and water.
5. Make sure reinforcing steel is free of loose rust or mortar coatings from previous lifts.
6. Check to determine all items to be embedded are adequately secured in place.

B. Examples of deficient items needing correction include:

1. Forms not spaced properly.
2. Dimensions not correct.
3. Forms placed before rebars in place.
4. Forms not structurally sound.

VI. Reinforcing Steel

A. Common items to inspect:

1. Ensure the reinforcing steel is stored off the ground and in adequate space for sorting and checking.

2. Make sure that the steel is free from mud, concrete, grease, oil, paint, loose rust or other coatings, prior to placing concrete and that it is the proper tensile strength.
3. Check steel in place for size, proper bends, spacing, location, and correctness of installation.
4. Determine that proper splices, ties, spacers, anchorage, and cover exists.
5. See that bars are adequately supported with wires, metal chairs, spacers or concrete blocks of correct mix and strength.
6. Ensure steel is not displaced during the pouring operations.

B. Examples of deficient items needing correction include:

1. Steel not of proper size.
2. Steel bar laps not adequate.
3. Steel not properly placed.
4. Steel not properly anchored to prevent displacement during concrete placement.
5. Steel contains old concrete, grease, oil, paint, or scaly rust.

VII. Joints and Water Stops

A. Common items to inspect:

1. Determine that all joints (expansion, contraction, construction) are located as shown on the drawings.
2. Make sure construction joints have been prepared as required.
3. Ensure joint filler has been installed and securely fastened in expansion joints.
4. Ensure water stops are firmly secured in correct location, undamaged and properly spliced or welded in accordance with manufacturer's instructions.

B. Examples of deficient items needing correction include:

1. Proper material not being used.
2. Required waterstops or joint material not in place prior to placement of concrete.

VIII. Concrete Delivery

A. Common items to inspect:

1. Observe concrete batch for uniformity at the time of placement. Any change from normal consistency or appearance could indicate a deviation from the approved mix.
2. Ensure additional water is not added to retemper concrete.
3. Ensure properly prepared batch tickets are delivered with each load of concrete.
4. Slump (if job specifies a requirement range).
5. Air content (if specified).
6. Length of time concrete is in mixer after water was added to the mix.

B. Examples of deficient items needing correction include:

1. Concrete mix contains too much water. Improper slump.
2. Cement content inadequate.
3. Concrete in mixer too long.

IX. Curing Concrete

A. Common items to inspect:

1. Determine that adequate curing and protective arrangements have been made before permitting concrete placing operations to start.
2. Make sure that the concrete is kept moist and above freezing for the specified time so that hydration of the cement can occur.
3. Ensure the curing media is applied to nonformed surfaces as soon as the concrete hardens sufficiently.
4. Ensure the formed concrete is cured as specified after removal of the forms.

B. Examples of deficient items needing correction include:

1. No curing measures being used or are inadequate.
2. Concrete allowed to freeze.

X. Structure Drainage

A. Common items to inspect:

1. Ensure drains are constructed to the cross sections, lines, elevations, and grades specified.
2. Be certain that drain and filter materials fully meet the specifications with respect to grading and grain size criteria, especially the allowable amount of fines.
3. Check adequacy of placing of drain material for segregation and contamination with unsatisfactory material.
4. Check that perforated pipe meets specification requirements and is correctly installed with the perforations down. Check to see that perforated holes are open.
5. Check that necessary precautions are taken to guard against displacement of the pipe during backfilling operations and that proper bedding has been provided.
6. Ensure upper ends of drain pipe are capped, when specified, and the required guards are installed at the outlet ends.
7. Check adequacy of geotextile as compared to the specifications.

B. Examples of deficient items needing corrections include:

1. Drains not to proper lines or grade.
2. Filter material contains too much fine material.
3. Filter material does not have proper gradation.
4. Improper geotextile material.

XI. Pipe Structures

A. Common items to inspect:

1. Make a visual inspection of each section of pipe. Check for defects in manufacturing and damage caused by handling.
2. Determine that the specified sizes, thicknesses, and quality of pipe and fittings have been delivered.
3. See that the excavation, including bedding, conforms to the lines and grades specified.
4. Check that each section of pipe is prepared, placed, joined, sealed, and supported as specified.
5. Determine that coupling bands on corrugated metal pipe are properly positioned and pulled tight.
6. Check that damaged coatings and other untreated areas are properly coated prior to placing backfill.
7. Determine that the quality of the backfill material is adequate, spreading is satisfactory and compaction meets the requirements.
8. Check for movement of pipe while backfill is placed or during compaction.

B. Examples of deficient items needing correction include:

1. Pipe not of proper length, diameter, or thickness.
2. Metal pipe contains loose rivets or seams.
3. Poor workmanship during fabrication or improper fabrication.
4. Pipe damaged (bent, punctured, cracked, broken) during shipment or installation.
5. Pipe not in conformance to required material specification such as seams not caulked when specified or fabrication incorrect.
6. Couplings bands and anti-seep collars not securely tightened.
7. Coupling bands and anti-seep collars not sealed or caulked adequately.
8. Bedding for pipe improper.
9. Pipe is displaced during compaction of backfill.
10. Pipe not to proper grade.

XII. Installation Timber Structures

A. Common items to inspect:

1. Check that all members are of correct dimensions, grade, and species.

2. Check that members are properly aligned and fitted together with full bearing and without shims or other adjusting devices, except as specifically permitted.
3. See that bolt holes are properly located and bored to correct alignment.
4. Check that all bolted connections are tight just prior to acceptance of the work. Drying and seasoning of wood usually results in bolts becoming loose.
5. Check that proper fasteners were used.
6. Make sure all wood contains the specified level of preservative.

B. Examples of deficient items needing correction include:

1. Dimensions not correct.
2. Post spacing not correct.
3. Species of lumber different from design assumptions.
4. Treatment inadequate.
5. Fastening inadequate.

XIII. Rock Riprap

A. Common items to inspect:

1. Determine the surfaces to be protected are to the lines and grades shown on the drawings, and are free of unstable material.
2. Make sure that rock and filter materials or geotextile meet the quality and gradation requirements specified. Test results are usually required for rock.
3. Do not permit soil fines to become intermixed with the riprap during placing operations.
4. Determine that rock is placed to the required thickness. Make sure the method of placement is adequate to prevent segregation of rock sizes.
5. Check the riprap after placing to determine that rock sizes are well distributed and that minimum sizes properly fill the voids between the large rock.

B. Examples of deficient items needing correction include:

1. Filter material or geotextile not proper before placing riprap.
2. Improper gradation of rock.
3. Segregation of rock during placement.
4. Thickness of rock inadequate.
5. Toe anchorage incorrect.

XIV. Vegetation

A. Common items to inspect:

1. Placement of topsoil (if applicable).
2. Application of needed lime and/or fertilizer.
3. Seed quantities based on pure live seed (PLS).

4. Allowable seeding dates.
5. Mulch application.

B. Examples of deficient items needing correction include:

1. Seed varieties other than specified.
2. Required lime and/or fertilizer not applied.
3. Proper seeding schedule not followed.
4. Planned mulch or other needed measures not applied.
5. Excessive delays between construction and seeding operations.

Construction Tests

Due to individual site conditions, design, or design requirements, certain tests of soils may be required prior to design and/or during construction. The wording of the conservation practice standard, construction specification, or requirements contained in construction drawings will determine whether tests are required.

Tests are required whenever the standard or specification makes a statement regarding the minimum requirements. For example, if the requirement is that 50 percent of the material must pass the #200 sieve or lining is required, then tests are required to support this determination that lining, in fact, was not needed. If, by field examination, it can be determined that lining is required, then no tests of foundation soils are necessary; however, tests are required to determine the adequacy of the material proposed for the lining.

The construction drawings or specifications may state that various tests are to be performed by the contractor. The contractor is responsible for obtaining the tests and assuring that they are performed properly and by competent personnel. The test results are to be provided to inspection staff for verification of project requirements.

Documentation

Written documentation should be made of all items inspected and the resultant findings. Deficient items found should be noted and a statement made on how deficiencies were corrected. People involved in the discussions should be noted. It is extremely important the land user be informed immediately of deficient items so he or she may promptly instruct the contractor on needed corrections. Policy on the use of job diaries is contained in Part 512 of the National Engineering Manual. Job diaries are required for all NRCS funded projects.

Documentation for various dimensions, sizes, and materials may include written statements from the contractor. These statements must be signed, identified by the job, and be dated. Other requirements for accepting signed statements by the contractor are contained in Part 505 of the National Engineering Manual.

This page reserves pages 17-WI-15 through 17-WI-30 for future supplements.