GUIDELINES FOR SPECIAL INSPECTION IN CONSTRUCTION

PREPARED FOR THE BUILDING INDUSTRY

by

CALIFORNIA COUNCIL OF TESTING AND INSPECTION AGENCIES

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ORIGINS OF
CALIFORNIA COUNCIL OF TESTING AND INSPECTION AGENCIES

The Association of Northern California Testing and Inspection Agencies' (ANCTIA's) roots go back to approximately 1970 when several San Francisco Bay Area testing and inspection firms (materials engineering laboratories) decided to unite their efforts in an attempt to achieve more uniform guidelines for, and enforcement of, what was then Section 305 of the Uniform Building Code (UBC) dealing with "Special Inspection". At that time, the public agencies use and enforcement of code-dictated special inspection varied from zero to total "by-the-book" requirements. Thus materials engineering laboratories often faced major uncertainties as to how strictly they must adhere to UBC "requirements". This, in turn, created substantial inequities in levels of effort, especially confusing to clients that built in more than one jurisdiction.

Early efforts were encouraging enough that ANCTIA survived many years and achieved substantial progress, as exhibited by the following achievements:

- Creation of a "Tests and Inspection" (T & I) checklist prototype for use on commercial/private construction projects
- Establishment of inspection guidelines
- Established criteria for issuance of inspector identification cards, signed by Professional Engineers, and listing the individual's areas of expertise.

After some time, activities slowed down, only to be revived again about 1987, for most of the same reasons that resulted in the original formation, i.e. lack of uniform use and enforcement of special inspection code requirements. This time ANCTIA became even more proactive, with such projects as:

- T & I checklist update
- Established minimum standards for member firms
- Revised minimum standards for inspectors
- Promoted the active use of inspector identification cards
- Interacted with ICBO and local building officials

The organization has evolved into a statewide organization with the title: California Council of Testing and Inspection Agencies (CCTIA).

As with its predecessor, CCTIA is a non-profit public benefit corporation dedicated to fostering, promoting, and encouraging through education, the practice and profession of materials testing and inspection services. The Council influences code development, training programs, and minimum inspector and agency qualification standards through its member firms' representation in many other organizations, including:

- International Conference of Building Officials (ICBO) (including various Chapters throughout the State of California)
- ICBO's Northwest Advisory Committee for Special Inspection
- ICBO's Special Inspection Advisory Committee to the Education Committee
- Structural Engineers Association of California (SEAOC)
- American Council of Independent Laboratories (ACIL)
- American Concrete Institute (ACI)
- American Construction Inspectors Association (ACIA)
- American Society for Testing and Materials (ASTM)
- ASTM E36 Committee on Laboratory Accreditation

There are many more organizations, too numerous to include within this document, in which the Council participates and supports in its efforts of promoting public safety.

Questions and inquiries concerning CCTIA membership may be made by contacting any member firm.

INTRODUCTION

This manual, entitled "Guidelines for Special Inspection in Construction", has been prepared by the member firms of the California Council of Testing and Inspection Agencies (CCTIA) to illustrate the services available in some of the more common categories of special inspection and testing. The Manual of Practice for Materials Engineering Testing and Inspection, published by American Council of Independent Laboratories, was used with their permission as a reference to assist in the development of this Guideline.

A basic objective of this Council (CCTIA) is to provide information that will assist clients to better understand the relationship between testing and inspection agencies (materials engineering laboratories) and specific requirements of the various building codes. Of particular importance is the capability of such agencies to satisfy the Special Inspection requirements of the Uniform Building Code, other local codes, and the typical requirements of project specifications.

The guidelines are not meant to imply that all of these services will be required on any specific project, or that the agency has been directed to perform all of the available services within a category. It is also recognized that special requirements of specific projects or governing agencies may require more or less stringent procedures than those outlined in these guidelines.

Inspection is the observation of construction for general conformance with the approved design drawings and specifications. It shall not be relied upon by others as acceptance or guarantee of work, nor shall it in any manner relieve any contractor, or any other party, from their obligations and responsibilities under the construction contract, or generally accepted industry custom.

It is important to note that qualified materials engineering laboratories may provide testing, inspection and materials engineering services in many fields other than those selected for this publication. In addition, a qualified laboratory should comply with ASTM E329, *Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.*

UNIFORM BUILDING CODE AND STRUCTURAL TESTS AND INSPECTION SCHEDULE

Certain types of construction shall have **continuous** inspection as specified in Section 1701. For the convenience of our clients, we have reproduced on the next pages, with permission of ICBO, Section 1701, *Special Inspections*, of the 1997 Edition of the Uniform Building Code.

Also, on pages 22-23, we have reproduced a copy of the Structural Tests and Inspection Schedule developed by this council. Copies of this checklist for use on construction projects may be obtained from any member of CCTIA.

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Following is Section 1701, *Special Inspections* and Section 1703, *Nondestructive Testing* as they appear in the 1997 Edition of the Uniform Building Code*.

SECTION 1701 - SPECIAL INSPECTIONS

1701.1 General. In addition to the inspections required by Section 108, the owner or the engineer or architect of record acting as the owner's agent shall employ one or more special inspectors who shall provide inspections during construction on the types of work listed under Section 1701.5.

EXCEPTION: The building official may waive the requirement for the employment of a special inspector if the construction is of a minor nature.

1701.2 Special Inspector. The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the building official, for inspection of the particular type of construction or operation requiring special inspection.

1701.3 Duties and Responsibilities of the Special Inspector. The special inspector shall observe the work assigned for conformance with the approved design drawings and specifications.

The special inspector shall furnish inspection reports to the building official, the engineer or architect of record, and other designated persons. All discrepancies shall be brought to the immediate attention of the contractor for correction, then, if uncorrected, to the proper design authority and to the building official.

The special inspector shall submit a final signed report stating whether the work requiring special inspections was, to the best of the inspector's knowledge, in conformance with the approved plans and specifications and the applicable workmanship provisions of this code.

1701.4 Standards of Quality. The standards listed below labeled a "U.B.C. standard" are also listed in Chapter 35, Part II, and are part of this code. The other standards listed below are recognized standards. (See Sections 3503 and 3504).

1. **Concrete.**

ASTM C 94, Ready-mixed Concrete

2. **Connections**

Specifications for Structural Joints using ASTM A 325 or A 490 Bolts-Load and Resistance Factor Design, Research Council of Structural Connections, Section 1071.5, Item 6.

Specification for Structural Joints using ASTM A 325 or A 490 Bolts-Allowable Stress Design, Research Council of Structural Connections, Section 1701.5, Item 6.

3. **Spray-applied Fire-resistive Materials.**

UBC Standard 7-6, Thickness and Density Determination for Spray-applied Fire-resistive Materials.

1701.5 Types of Work. Except as provided in Section 1701.1, the types of work listed below shall be inspected by a special inspector.

1. **Concrete.** During the taking of test specimens and placing of reinforced concrete. See Item 12 for shotcrete.

EXCEPTIONS: 1. Concrete for foundations conforming to minimum requirements of Table 18-l-C or for Group R, Division 3 or Group U, Division 1 Occupancies, provided the building official finds that a special hazard does not exist.

2. For foundation concrete, other than cast-in-place drilled piles or caissons, where the structural design is based on an f'_c no greater than 2,500 pounds per square inch (psi) (17.2 MPa).

3. Nonstructural slabs on grade, including prestressed slabs on grade when effective prestress in concrete is less than 150 psi. (1.03 MPa).

4. Site work concrete fully supported on earth and concrete where no special hazard exists.

2. **Bolts installed in concrete.** Prior to and during the placement of concrete around bolts when stress increases permitted by Footnote 5 of Table 19-D or Section 1923 are utilized.

3. **Special moment-resisting concrete frame.** For moment resisting frames resisting design seismic load in structures within Seismic Zones 3 and 4, the special inspector shall provide reports to the person responsible for the structural design and shall provide continuous inspection of the placement of the reinforcing and concrete.

4. **Reinforcing steel and prestressing steel tendons.**

4.1 During all stressing and grouting of tendons in prestressed concrete.

4.2 During placing of reinforcing steel and prestressing tendons for all concrete required to have special inspection by Item 1.

EXCEPTION: The special inspector need not be present continuously during placing of reinforcing steel and prestressing tendons, provided the special inspector has inspected for conformance with the approved plans prior to the closing of forms or the delivery of concrete to the jobsite.

5. **Structural welding.**

5.1 **General**. During the welding of any member or connection which is designed to resist loads and forces required by this code.

EXCEPTIONS: 1. Welding done in an approved fabricator's shop in accordance with Section 1701.7.

2. The special inspector need not be continuously present during welding of the following items, provided the materials, qualifications of welding procedures and welders are verified prior to the start of work; periodic inspections are made of work in progress; and a visual inspection of all welds is made prior to completion or prior to shipment of shop welding:

2.1 Single-pass fillet welds not exceeding 5/16 inch (7.9 mm) in size.
2.2 Floor and roof deck welding.
2.3 Welded studs when used for structural diaphragm or composite systems.
2.4 Welded sheet steel for cold-formed steel framing members such as studs and joists.
2.5 Welding of stairs and railing systems.

5.2 **Special moment-resisting steel frames**. During the welding of special moment-resisting steel frames. In addition to Item 5.1 requirements above, nondestructive testing as required by Section 1703 of this code.

5.3 **Welding of reinforcing steel**. During the welding of reinforcing steel.

EXCEPTION: The special inspector need not be continuously present during the welding of ASTM A706 reinforcing steel not larger than No. 5 bars used for embedments, provided the materials, qualifications of welding procedures and welders are verified prior to the start of work; periodic inspections are made of work in progress; and a visual inspection of all welds is made prior to completion or prior to shipment of shop welding.

6. **High-strength bolting**. The inspection of high-strength A 325 and A 490 bolts shall be in accordance with approved nationally recognized standards and the requirements of this section. While the work is in progress, the special inspector shall determine that the requirements for bolt, nuts, washers and paint; bolted parts, and installation and tightening in such standards are met. Such inspections shall be performed on a periodic basis in accordance with the requirements of Section 1701.6. The special inspector shall observe the calibration procedures when such procedures are required by the plans or specifications and shall monitor the installation of bolts to determine that all plies of connected materials have been drawn together and that the selected procedure is properly used to tighten all bolts.

7. **Structural masonry**.

7.1 For masonry, other than fully grouted open-end hollow-unit masonry, during preparation and taking of any required prisms or test specimens, placing of all masonry units, placement of reinforcement, inspection of grout space, immediately prior to closing of cleanouts, and during all grouting operations.

EXCEPTION: For hollow-unit masonry where the *fm* is no more than 1,500 psi (10.34 MPa) for concrete units or 2,600 psi (17.93 MPa) for clay units, special inspection may be performed as required for fully grouted open-end hollow-unit masonry specified in Item 7.2 below.

7.2 For fully grouted open-end hollow-unit masonry during preparation and taking of any required prisms or test specimens, at the start of laying units, after the placement of reinforcing steel, grout space prior to each grouting operation, and during all grouting operations.

EXCEPTION: Special inspection as required in Items 7.1 and 7.2 above need not be provided when design stresses have been adjusted as specified in Chapter 21 to permit noncontinuous inspection.

8. **Reinforced gypsum concrete**. When cast-in-place Class B gypsum concrete is being mixed and placed.
9. **Insulating concrete fill**. During the application of insulating concrete fill when used as part of a structural system.

EXCEPTION: The special inspections may be limited to an initial inspection to check the deck surface and placement of reinforcing. The special inspector shall supervise the preparation of compression test specimens during this initial inspection.

10. **Spray-applied fire-resistive materials**. As required by U.B.C. Standard 7-6.
11. **Piling, drilled piers and caissons**. During driving and testing of piles and construction of cast-in-place drilled piles or caissons. See Items 1 and 4 for concrete and reinforcing steel inspection.
12. **Shotcrete**. During the taking of test specimens and placing of all shotcrete and as required by Sections 1924.10 and 1924.11.

EXCEPTION: Shotcrete work fully supported on earth, minor repairs and when, in the opinion of the building official, no special hazard exists.

13. **Special grading, excavation and filling**. During earthwork excavations, grading and filling operations inspection to satisfy requirements of Chapter 18 and Appendix Chapter 33 of this code.
14. **Smoke-control system**.

14.1 During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.
14.2 Prior to occupancy and after sufficient completion for the purposes of pressure difference testing, flow measurements, and detection and control verification.

15. **Special cases**. Work which, in the opinion of the building official, involves unusual hazards or conditions.

1701.6 Continuous and Periodic Special Inspection

1701.6.1 Continuous special inspection. Continuous special inspection means that the special inspector is on the site at all times observing the work requiring special inspection.

1701.6.2 Periodic special inspection. Some inspections made be made on a periodic basis and satisfy the requirements of continuous inspection, provided this periodic scheduled inspection is performed as outlined in the project plans and specifications and approved by the building official.

1701.7 Approved Fabricators Special inspections required by this section and elsewherein this code are not required where the work is done on the premises of a fabricator registered and approved by the building official to perform such work without special inspection. The certificate of registration shall be subject to revocation by the building official if it is found that any work done pursuant to the approval is in violation of this code. The approved fabricator shall submit a certificate of compliance that the work was performed in accordance with the approved plans and specifications to the building official and the engineer or architect of record. The approved fabricator's qualifications shall be contingent on compliance with the following:

1. The fabricator has developed and submitted a detailed fabrication procedure manual reflecting key quality control procedures that will provide a basis for inspection control of workmanship and fabricator plant.

2. Verification of the fabricator's quality control capabilities, plant and personnel as outlined in the fabrication procedural manual shall be by an approved inspection or quality control agency.

3. Periodic plant inspections shall be conducted by an approved inspection or quality control agency to monitor the effectiveness of the quality control program.

4. It shall be the responsibility of the inspection or quality control agency to notify the approving authority in writing of any change to the procedural manual. Any fabricator approval may be revoked for just cause. Reapproval of the fabricator shall be contingent on compliance with quality control procedures during the past year.

SECTION 1703 - NONDESTRUCTIVE TESTING

In Seismic Zones 3 and 4, welded, fully restrained connections between the primary members of ordinary moment frames and special moment-resisting frames shall be tested by nondestructive methods for compliance with approved standards and job specifications. This testing shall be a part of the special inspection requirements of Section 1701.5. A program for this testing shall be established by the person responsible for structural design and as shown on plans and specifications.

As a minimum, this program shall include the following:

1. All complete penetration groove welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.

> **EXCEPTIONS**: 1. When approved, the nondestructive testing rate for an individual welder or welding operator may be reduced to 25 percent, provided the reject rate is demonstrated to be 5 percent or less of the welds tested for the welder or welding operator. A sampling of at least 40 completed welds for a job shall be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects dived by the number of welds completed. For evaluating the reject rate of continuous welds of 3 feet (914 mm) in length where the effective throat thickness of 1 inch (25 mm) or less, each 12-inch increment (305 mm) or fraction thereof shall be considered as one weld. For evaluating the reject rate on continuous welds over 3 feet (914 mm) in length where the effective throat thickness is greater than 1 inch (25 mm), each 6 inches (152 mm) of length or fraction thereof shall be considered one weld.
> 2. For complete penetration groove welds on materials less than 5/16 inch (7.9 mm) thick, nondestructive testing is not required; for this welding, continuous inspection is required.
> 3. When approved by the building official and outlined in the project plans and specifications, this nondestructive ultrasonic testing may be performed in the shop of an approved fabricator utilizing qualified test techniques in the employment of the fabricator.

2. Partial penetration groove welds when used in column splices shall be tested either by ultrasonic testing or radiography when required by the plans and specifications. For partial penetration groove welds when used in column splices, with an effective throat less than 3/4 inch (19.1 mm) thick, nondestructive testing is not required; for this welding, continuous special inspection is required.

3. Base metal thicker than 1_ inches (38 mm), when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities directly behind such welds after joint completion.

Any material discontinuities shall be accepted or rejected on the basis of the defect rating in accordance with the (larger reflector) criteria of approved national standards.

SECTION 1

EARTHWORK
(Special Grading, Excavation and Filling)

OBJECTIVE

Earthwork as presented in this section includes, in general, those soils construction activities normally associated with special grading, excavation and filling. The purpose of earthwork observation and testing is to verify that the work is done in compliance with the approved plans and specifications, and, in particular, the recommendations of the project geotechnical report.

Soil is a highly variable material, very sensitive to moisture fluctuations, and requires close attention to construction quality control in order to achieve the desired result. Many factors contribute to its suitability and effective performance. Identifying and properly controlling these factors can be divided into two general areas of activity. The first involves the observation or monitoring during construction with particular attention that placement and compaction operations are followed as specified in the contract documents and geotechnical report. The second involves tests to document the soils properties and verify compliance to the quality specified.

Materials engineering laboratories that offer services in this field provide special expertise and equipment to verify the objectives of the design and project specifications. However, this is best accomplished when the Design Geotechnical Consultant provides these construction related services and can in turn achieve continuity and integration of the design-construct process. Without involvement of this Geotechnical Engineer, the constructed earthwork may not meet the performance requirements intended.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and the Geotechnical Engineer's report.
2. Note and record the equipment being used on site.

B. Sampling of Materials

1. Sample and verify that the following materials are delivered to the Materials Engineering Laboratory for any required testing:
   a) Subgrade materials,
   b) Native-fill materials,
   c) Imported materials, and
   d) Additive materials (lime, cement, sand, pozzolan, etc.)

C. Testing

1. Perform soils classification and properties tests as required on native and/or imported soils.
2. Perform laboratory moisture-density relationship tests or other structural property tests as required.
3. Where applicable, conduct laboratory testing program to determine soils' properties resulting from admixtures such as cement or lime.
4. In the field, conduct in-place field density and moisture tests using procedures specified in the contract documents. Frequency of testing should be predetermined to allow for representative coverage of each lift, while interfering as little as possible with the earthwork operation's schedule.
5. Testing must be timely to avoid having to retest previously covered work. Similarly, test methods should be predetermined so as to take into account the Contractor's procedures and soil types.
6. Periodic sampling of materials in the field to verify continued compliance with specification requirements is recommended.

D. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work.

SECTION 2

ASPHALTIC CONCRETE

OBJECTIVE

The performance of asphaltic concrete pavement is as much affected by the careful construction of the subgrade and base as it is by the control of the asphaltic concrete itself. Therefore, the paving inspector must be knowledgeable in soils as well. The purpose of observation and testing of asphaltic concrete paving is to verify that the paving contractor and his supplier are exercising adequate quality control in their operations and are providing a finished product that complies with the project plans and specification requirements.

This objective can best be achieved by qualified special inspectors performing the following duties under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans and specifications, and meet with contractor and suppliers before construction to discuss project and to verify that requirements for testing and observation are well understood.
2. Review material certificates and test reports for compliance with job specifications.
3. Prepare or review mix designs for compliance to project requirements.

B. Sampling of Materials

1. Sample and perform preliminary tests on proposed aggregates and asphalt cement (gradation, soundness, abrasion, stripping, etc.)

C. Subgrade and Base

1. Confirm that sources of materials have been sampled and approved.
2. Verify that materials delivered are of uniform quality.
3. Verify that control testing of subgrade materials is being performed and recorded as required.
4. Verify that subbase and base courses are of the source, type, thickness and density specified.
5. Verify that soil sterilization is provided, if required.
6. Refer to Section 1, Earthwork for additional details.

D. Batch Plant

1. The special inspector should become familiar with the appearance and physical characteristics of the mix to be used by observing visually the finished mixture so that unsatisfactory conditions may be readily recognized.
2. Check the batch plant facilities prior to production of asphaltic concrete mixture.
3. Check aggregates in stockpile to verify conformance to materials utilized in the design.
4. Check the bin weights of the aggregate fractions and asphaltic cement (batch plant only).
5. Check the temperature of the mixed batches on the truck.
6. Perform hot-bin gradations of the blended aggregates (where applicable).
7. Verify cold-bin feeds and hot-bin batch weights are adjusted as necessary to produce the job-mix formula within tolerance.
8. Before loading, truck beds should be checked for cleanliness and absence of materials that might be detrimental to the mix.
9. Coordinate with the job site inspector to obtain a uniform and consistent asphaltic concrete mixture.

E. Spreading and Paving

1. The field inspector should contact the batch plant inspector promptly should conditions be observed during placement and spreading operations that suggest a need for change at the plant. The following items should be addressed prior to and during placement operations:
   a) Area to be paved, cleaned and properly primed, or tack coated.
   b) Leveling course installed where required.
   c) Suitability of spreading and paving equipment.
   d) Asphalt mix temperature when delivered, and after final rolling, is within limits required.
   e) Density tests by nuclear gauge during rolling.
   f) Thickness control by adequate placement and compaction.
   g) Sampling of asphaltic concrete at jobsite during placement for laboratory testing (extraction, gradation, stability, etc.)
   h) Core samples taken for verification of thickness and density of in-place asphaltic concrete.
   i) Application of seal coat and curing in accordance with specification requirements, if required.

F. Verification Tests

1. Stability and density, bulk specific gravity and maximum specific gravity.
2. Asphalt content by extraction.
3. Aggregate gradation of the mixture from extracted sample.
4. Physical properties of the asphalt cement: Penetration, viscosity, ductility, and specific gravity.
5. Aggregate quality: Los Angeles abrasion, liquid limits of soils and plastic limit and plasticity index, and sieve analysis.
6. Field density.
7. Thickness determination.
8. Smoothness tolerance.

G. Reports

1. Submit written progress reports describing the tests made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect engineer. Report all uncorrected deviations from plans or specifications.

SECTION 3

REINFORCING STEEL

OBJECTIVE

The purpose of reinforcing steel observation is to give assurance that the supplier is exercising satisfactory control over production, fabrication and placing of reinforcing steel so that it meets the project specifications and applicable codes and industry standards.

This objective can best be achieved by qualified special inspectors who diligently perform the duties listed below while under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and approved shop drawings.
2. Review applicable sections of referenced codes, such as: the Uniform Building Code and Uniform Building Standards (ICBO); the Building Code, Requirements for Reinforced Concrete (ACI-318) by the American Concrete Institute (ACI); the Manual of Standard Practice of the Concrete Reinforcing Steel Institute (CRSI); the Reinforcing Steel Welding Code (AWS D1.4) by the American Welding Society (AWS).

B. Mill Test Reports

1. Verify reinforcing steel mill test reports (when available) for mill markings and test data, checking against project requirements.
2. Sample material for tests directly from unopened bundles when required by specifications.

C. Fabrication

1. Check each shipment of reinforcing steel for the following:
   a) Bar sizes and grades are as specified.
   b) Mill marking is in conformance with mill test reports.
   c) Check for corrosion, contaminants, surface cracks and bars damaged in shipment.
   d) Check shop bends for specified radius and cracks.

D. Placement

1. During placement of reinforcing, check for proper bar locations, alignment, laps, ties, form and ground clearance, supports, field bend radii and cracks, gouges or tack welds causing stress concentrations, removal of contaminants, and hardened concrete.
2. If welding of reinforcing is required, it should be observed as defined in UBC Section 1701.5(5.3), with particular emphasis on joint configuration, suitability of low hydrogen electrodes, preheat and interpass temperatures, and interpass slag removal. Check for welding and procedures for conformance to AWS D1.4.
3. Prior to concrete placement, check for complete installation and notify contractor of any variations from plans and specifications. If variations are not corrected prior to start of concreting, immediately notify the design team representative and the building office for appropriate action.
4. During concrete placement, check that reinforcing stays in place and is adequately supported. Check for removal of dirt, concrete spatter, grease, or other contaminants.
5. Check embedded items, including anchorages, inserts, and bolts installed in concrete for compliance to project documents. Verify they are solidly cast in place during placement of concrete.

E. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 4

CONCRETE BATCH PLANT

OBJECTIVE

The purpose of batch plant observation is to verify that the concrete supplier is exercising adequate quality control to produce concrete that will meet the project requirements for materials, their batch proportions, mixing and adjustment for moisture.

This objective can best be achieved by qualified special inspectors who diligently perform the duties listed below while under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Verify that the class of concrete ordered is being delivered and conforms with approved mix designs.

B. Equipment

1. Check the trucks for worn out or damaged fins, excessive buildup of hardened concrete, and for the presence of wash water from the previous delivery.
2. Check the National Readymix Concrete Manufacturers Association truck rating plate and verify that load capacities are not exceeded.
3. Check the current "weights and measures" seal on scales.
4. Verify that the moisture metering device is operable.
5. Verify that the scales start at and return to zero after each weighing operation.
6. Verify that the metering devices for admixtures have been calibrated recently and are operating.

C. Materials, Storage and Handling

1. Visually check the sand and coarse aggregate for method of storage, handling, source, grading, cleanliness, and moisture condition.
2. Obtain samples of aggregates when specified or when it appears that they may not conform to the required gradation or cleanliness.
3. Obtain grab samples of cement and pozolanic materials when required by project specifications.
4. Check cement temperature.
5. For lightweight aggregates, check loose moist unit weight regularly and verify whether the plant is making proper adjustments to batch weights to compensate for variations in weight as well as moisture.

D. Batching of Materials

1. Record the volume in cubic yards for each class of concrete delivered. Verify that each mix proposed for delivery is of the proper designation and proportions approved for the project. Where discrepancies occur, request that the dispatcher clarify with the general contractor.
2. Verify that the specified materials are dispensed to the weigh hopper and record the adjusted batch weights for all ingredients in the desired proportions of the concrete mix.
3. Verify that the proper adjustments have been made for variations in moisture of aggregates.
4. Record the mixing time and check whether it is sufficient.
5. Visually estimate the slump of the concrete and report immediately to the operator any outside that specified.
6. Coordinate with the job site and verify the "as delivered" slump, air content, unit weight, mix temperature, general workability, and preparation of test samples.

E. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 5

CONCRETE

OBJECTIVE

Because so many factors interact to affect the ultimate quality of concrete, it has earned a reputation as one of the most variable of construction materials. To deal properly with all these factors, quality assurance is divided into two easily recognized categories or phases.

The first involves collecting evidence from standard tests to demonstrate that the delivered concrete was produced to the quality specified.

The second involves the enforcement of good construction practices during placement, finishing, and curing to achieve a satisfactory finished product.

These two objectives of quality assurance can best be achieved by qualified special inspectors who diligently exercise judgment in following the duties listed below while under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans and specifications.
2. Verify that the class of concrete ordered is being delivered and conforms with specifications, drawings and/or code requirements.

B. Observation Procedures

1. Check forms for cleanliness and proper treatment prior to placement.
2. Visually estimate the slump of each batch delivered and perform slump tests regularly.
3. Determine concrete temperature, number of mixing revolutions, and/or length of time since batching.
4. Observe placement procedures for evidence of segregation, possible cold joints, displacement of reinforcing or forms, and proper support of embedded items, anchor bolts, etc.
5. Inspect for proper compaction/consolidation.

C. Sampling and Testing Duties

1. Sample and test fresh concrete for the following (or as stipulated by plans and specifications):
   a) Slump
   b) Entrained air
   c) Temperature
   d) Wet unit weight, when required
2. Sample concrete and prepare test cylinders in accordance with ASTM C31.
3. Field sampling and testing of concrete should be performed by a qualified technician, certified as an ACI - Grade I Concrete Field Testing Technician.

D. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

NOTE: Unless otherwise contracted for, concrete observation may not include verification of reinforcing, other embedded items, form dimensions or alignment, or finishing and curing procedures.

SECTION 6

SHOTCRETE

OBJECTIVE

The purpose of special observation for shotcrete is to verify that the materials, processes and the particularly unique application techniques conform to the project documents. The process moves rapidly in often noisy and congested environments; it relies heavily on experienced working crews.

The quality control objectives can best be achieved by a thoroughly experienced special inspector who understands shotcrete as an extension of his or her concrete inspection knowledge and is under the direct supervision of a qualified materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and contractor submittals for applications process used.
2. Verify crew qualifications.
3. Verify material sources and approved mix design.
4. Verify test methods and sample procedure.

B. Observation Procedures

1. Verify main and auxiliary equipment for compliance, capacity, pressures, and proper functioning.
2. Check for hot or cold weather limitations and precautions.
3. Verify reinforcing has been previously inspected and placed for minimal congestion.
4. Verify all joints, penetrations, embeds, and formwork are correct and adequately supported.
5. Verify the nozzleman has suitable shooting positions and access to achieve placement with minimal rebound.
6. Check for ground wires or other thickness gauging control method.
7. Review mixing and placing procedures with crew before commencement of application.
8. Observe placement for:
   a) Consistency
   b) Consolidation
   c) Coverage
   d) Rebound
   e) Finish
   f) Cure
9. Check completed job for defects and corrective action.

C. Sampling and Testing

1. Prepare a test panel 18” x 18” x 3”, or as otherwise specified to obtain suitable cores for testing. Arrange correct positioning of sample panel to represent job shotcrete. Prearrange with nozzleman the correct timing of the test sample preparation and verify that it is representative of job placement, finish, and cure. Refer to ACI 506 for further guidance.
2. Mark panel with specimen identification and protect for curing period

D. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 7

PRE-TENSIONED CONCRETE

OBJECTIVE

Because the strength of materials used in prestressed construction is significantly higher than normal concrete construction, there has developed a strong quality control program by plant manufacturers. As a result, the purpose of pre-tensioned concrete plant observation is to verify the actual control program and check its effectiveness.

This objective can best be achieved by qualified special concrete inspectors performing the following duties under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. **Documents**
1. Review the approved plans, specifications, and approved shop detail drawings.
2. Verify that concrete mix designs, tensioning data, and calculations for stressing have been approved by the reviewing authority.
3. Verify that jacking equipment has been calibrated.

B. Mill and Plant Test Reports
1. Check conformance of all materials to project specifications. Verify steel mill test reports for prestressing steel and deformed bar steel. Verify mill markings and tags. Verify cement mill test reports and certification.
2. Check fabricator's testing facility and reporting of tests performed under fabricator's quality control program.

C. Sampling
1. Sample and deliver or ship to the laboratory for testing the following when independent tests are required by project specifications:
   a) Concrete aggregates
   b) Prestressing strand or wire
   c) Reinforcing steel
   d) Steel used for structural steel embedded items

D. Steel Fabrication of Embedded Items
1. Verify that qualified welders are employed to perform welding of structural steel using welding procedures qualified in accordance with AWS Structural Welding Code.

E. Pre-Placement Observations
1. Bed layout and form cleanliness.
2. Quantity and spacing of reinforcing and stressing steel.
3. Location of inserts and embedded items.
4. Profile of stressing steel.
5. Witness tensioning of prestressing elements, measure elongation of strand, and record gauge pressure.

F. Tests and Observation During Casting
1. Perform batch plant observations.
2. Conduct slump, air, and unit weight tests. Request adjustments as necessary.
3. Cast compression test specimens.
4. Observe placement and vibration of concrete in forms.
5. Observe finishing treatment.

G. Post-Placement Tests and Observations
1. Observe curing procedures, temperatures, and curing cycles.
2. Monitor compressive strength results for specified release strength.
3. Witness stress transfer.
4. Identify member by component and date cast.

H. Field Erection
1. Check members for damage during storage or shipment.
2. Check field installation and structural connections.

I. Reports
1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 8

POST-TENSIONED CONCRETE

OBJECTIVE

Post-tensioned concrete is normally constructed onsite rather than fabricated in plants. As a result, more responsibility is placed on the independent inspection agency to verify that quality control meets acceptable standards.

This objective can best be achieved by qualified special inspectors performing the following duties under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and approved placing and stressing drawings furnished by the post-tensioning contractor.
2. Review the reinforcing steel placing drawings to check whether they have been coordinated with the stressing drawings.

B. Mill Test Reports

1. Check that reinforcing steel and post-tensioning steel supplied to job is properly identified and mill test reports show conformance to project specifications.

C. Sampling of Materials

1. Sample and deliver to the laboratory for testing the following materials when required by project specifications:
   a) Concrete aggregates and cement
   b) Prestressing strand, rods or wire
   c) Reinforcing steel
   d) Steel used for structural inserts

D. Steel Fabrication of Embedded Items

1. Visit fabrication plant.
2. Verify that qualified welders only are welding in accordance with AWS Structural Welding Code.
3. Verify that only qualified welding procedures are being used.
4. Observe the welding operations and the finished product for defects and verify that corrections are made, if necessary.

E. Pre-Placement Observations

1. Check the general layout, size, spacing, and profile of all reinforcing steel and post-tensioning steel.
2. Observe all anchorages, inserts, embedded items, blockouts, conduits, etc.
3. Calibrate or review current calibration data on the proposed stressing equipment.

F. Observation During Placement of Concrete

1. Observe batch plant operations when required.
2. Observe concrete placement and report any damage or misalignment of any embedded components (with particular emphasis at end anchorages).
3. Cast compression test specimens.
4. Test slump, air content, and unit weight. Request adjustment as necessary.

G. Stressing

1. Verify that the concrete compressive strength meets the minimum required strength prior to post-tensioning.
2. Check the stressing sequence and verify the required posttensioning forces.
3. Call to the attention of the structural engineer any out of tolerance discrepancy in force-elongation relationship, spelled concrete, broken tendons, or anchorage slippage.
4. Verify friction losses where applicable.
5. When using bonded tendons, observe grouting procedure.

H. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 9

MASONRY

OBJECTIVE

The purpose of special observation for masonry is to verify that the workmanship and materials meet the minimum standards required by code, as well as the project specifications. This is particularly difficult in masonry work where so much is dependent upon the capabilities of the individual mason, as well as practices which have developed over the years and have become the custom of the trade for the particular locality. This requires experience and judgment by the inspector as well.

This objective can best be achieved by qualified special inspectors performing the following duties under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans and specifications with the masonry contractor and architect's representative in a preconstruction meeting to verify level of inspection required for the particular job. This is the time to resolve any differences in local custom or practice of the mason and requirements of the code and project specifications.

B. Mill Test Reports

1. Verify that mill test certifications for unit masonry, cement and reinforcing steel have been furnished by supplier and are acceptable to the architect/engineer.

C. Sampling of Materials

1. Sample and verify that the following materials are delivered to laboratory for testing when required by project specifications:
   a) Concrete block or brick
   b) Aggregates and cement for mortar and grout
   c) Reinforcing steel as delivered

D. Storage of Materials

1. Check that cement, lime, block and brick are supported on pallets and covered to protect from exposure to excessive moisture or drying.
2. Check that aggregates for mortar and grout are stored free from contamination and in such a manner as to minimize segregation.

E. Preparation for Lay-Up

1. Verify size and spacing of reinforcing dowels.
2. Verify that foundation concrete is clean and prepared as required by specifications.

F. Lay-Up or Placing of Masonry Units

1. Verify whether high lift or low lift procedures have been approved for use.
2. Verify that cleanouts are provided for first course of each pour, if high lift method is used.
3. Check plumb and lay-up configuration.
4. Check moisture condition of masonry units.
5. Verify that proper mortar ingredients and batching techniques are being used and prepare mortar compression test specimens.
6. Check mortar time on board.
7. Verify that head joints are the same thickness as face shells or that full head joints are used when specified.
8. Check that mortar extrusions (fins) are cleaned off inside.
9. Check whether joints are tooled as specified.
10. Check required frequency of masonry wall prisms and observe construction of same.
11. Check for ties when specified.
12. Check horizontal reinforcing steel placing:
    a) Placed at correct course, laps as specified.
    b) Check whether laps are staggered in bond beams and corners as required.
    c) Check lintel bars over openings.
    d) Check hooks, if called for in jambs.
    e) Check ties in piers, diameter, spacing, and properly fastened.
13. Check vertical reinforcing steel:
    a) Check bars at jambs, corners and piers, and typical wall steel.
    b) Check whether tied at top and bottom, and as required by project specifications.

G. Grouting Observations

1. Verify that cells and starting beds are clean. Check condition with light or mirror.
2. Check whether dowels, anchor bolts and inserts are all in place particularly at roof lines, floor lines and intersecting wall lines.
3. Check installation of cleanout closures.
4. Check grout mix and admixture required, etc.
5. Check slump in accordance with the specifications.
6. If low lift grouting, verify that maximum masonry height is in accordance with the code before grouting.
7. Check that grout is stopped below top for keying where required.
8. Verify mechanical vibrating during placement, and later during reconsolidation.
9. Continuous observation is required during grouting operations.
10. Prepare grout specimens in absorbent form, or as specified, for laboratory testing.
11. Check that curing requirements are being followed.

H. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 10

STRUCTURAL STEEL AND HIGH STRENGTH BOLTING

OBJECTIVE

The customary practice of fabrication of steel in the shop prior to erection conveniently allows division of observation of structural steel into two basic categories, shop and field. While the purpose is to assure that proper quality control is exercised at each location, the environment differs. Often the shop is fabricating other projects concurrently and may operate two or three shifts per day. The shop work is closely related to mass production, while the field work relates closer to handcrafting.

These duties should be performed by qualified special inspectors under the direct supervision of the materials engineering laboratory. To better achieve the objective of quality assurance, it is wise to use only one agency to fulfill the duties of both shop and field observation.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and approved shop drawings.
2. Review applicable sections of referenced codes, particularly the American Welding Society Structural Welding Code (AWS D1.1) and the Manual and Specifications of the American Institute of Steel Construction (AISC).
3. Review welding procedure qualifications when other than standard AWS prequalified joints and procedures are involved.

B. Mill Test Reports

1. Review mill test reports and check heat numbers with material as received. Verify that proper identification of steel is maintained during fabrication.

C. Sampling and Testing

1. When required by project specifications (particularly schools and hospitals), mark sample location with steel stamp on each piece tested.
2. Record sample number and location and check that sample identification is maintained as samples are delivered to laboratory and tested.
3. When steel members are delivered to finish length and no “crop ends” are available for sample cutting, coordinate cutting and patching requirements with architect/engineer and fabricator.

D. Welding Observation (Applicable to Shop and Field)

1. Check each welder's certification and verify that the welder does work only as covered by his certification.
2. Keep a written record of each welder by name, his identifying steel mark, and the percentage of rejectable welds.
3. Upon detection of a rejectable weld (either visually or by nondestructive test), the inspector-in-charge will notify the welder and/or his foreman for verification of defect. The inspector-in-charge will observe removal of defects and repairs to check whether acceptable procedures were used.
4. Check structural members for thickness adjacent to welds.
5. Inspect joints for proper preparation, including bevel, root faces, root opening, etc.
6. Check the type and size of electrodes to be used for the various joints and positions. Check the storage facilities to see if they are adequate to keep the electrodes dry.
7. Observe the technique of each welder periodically with the use of a welding inspection shield.
8. Verify the use of proper preheat and interpass temperatures.
9. Observe multi-pass welds continuously. Continuous observation is defined as follows: *The inspector is present in the welding area at all times.* The extent of inspection of individual welds will depend on the number of operators welding.
10. Observe single pass fillet welds periodically (in accordance with code requirements), after determining that the operator is capable of producing the welds required.
11. If straightening or restraining of weldments is necessary, verify that approved methods will be used.
12. Tag or stamp accepted weldments with the inspector's identification stamp.

E. Workmanship

1. Check straightening and bending procedures.
2. Check cut edges, including those flame cut, sheared, or milled.
3. Check bolt holes in major connections for size.

F. Additional Field Duties

1. Discuss welding sequence for general construction plans and for specific joint sequence with steel contractor and engineer to verify proper sequence to minimize restraint.
2. During adverse weather conditions, check that adequate steps are taken to prevent moisture penetration at welding location.

G. High Strength Bolting

1. Sample high strength bolts, washers, and nuts for testing from the lots in the shop or on the jobsite, if required.
2. Review type of joint specified (i.e. slip critical, nonslip critical).
3. Check bolts, nuts, and washers for compliance to project specifications.
4. Review the procedure for installation of bolts. The amount and type of inspection during installation will depend on the method used.
5. Check joint surfaces to verify that they are free of burrs, dirt, etc.
6. Verify installation procedures meet minimum bolt tensions required by code.
7. Check calibration of wrenches for tightening capacity in a wrench calibrator.

H. Painting

1. Verify cleaning operations to all surfaces to condition specified.
2. Verify conformance of paint to specification.
3. Verify application method, brush, roller, or spray.
4. Check for thickness of each coating, final thickness, and holidays.
5. Check touch-up for final finish

I. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 11

NONDESTRUCTIVE TESTING (NDT)

OBJECTIVE

The purpose of nondestructive testing is to verify that structural steel and/or completed welds are sound with respect to the given project criteria. Visual observation may not detect hidden fusion defects, cracking, and lamellar tearing. Therefore, it is important that all means necessary be available to the special inspector for reasonable verification of sound welds.

This objective can best be achieved by qualified NDT special inspectors performing standard test methods under the direction of the materials engineering laboratory. Since NDT tests are indirect (relying on a probing medium to disclose defects), accurate evaluation depends upon experienced, qualified personnel who are thoroughly trained in theory and applications.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and approved shop drawings.
2. Review applicable sections of referenced codes, particularly UBC Section 1703 and Section 6 of the AWS Structural Welding Code D1.1.
3. Where applicable, review welding procedures and sequences.

B. Personnel

1. All NDT personnel shall be qualified in accordance with the American Society for Nondestructive Testing, Recommended Practice SNT-TC-1A, and the supplement applicable to the method to be used. Only Level II and III inspectors, or Level I inspectors working under the direct supervision of a Level II or III inspector, are permitted to conduct the tests.

C. Method Selection

1. Method to be used shall be as prescribed by project specifications, building codes, or as recommended by the materials engineering laboratory under the direction of the design professional.
2. Effective use of NDT depends on utilizing the proper test method and techniques. Where field conditions or sequences affect the specified methods, the NDT technician will make recommendations for suitable approved methods or techniques.

D. Tests

1. Perform tests as prescribed by contract documents, for welds, laminations, or lamellar tearing.
2. Upon detection of a defect, mark the defect, and notify the foreman and/or the lead visual inspector.
3. Keep written records of pieces, welds, welder identification marks, length and location of defects, method and date of repair, number of retests, records of performance of each welder (percent of rejected welds), sampling rate, etc.

E. Reports

1. Submit written progress reports describing the tests and observations made, their location, and any corrective actions taken.
2. Report the current percent of rejectable welds.

F. Standards

1. Many nondestructive testing standards and codes are presently available for information and reference. Most standards and codes specify equipment and personnel requirements, operational steps, and acceptance standards tied to the end-use function. Following is a partial list of the more common standard test methods.
   a) Radiography - AWS D1.1, ASTM E94 and E99, ASME Section V.
   b) Ultrasonic Testing - AWS D1.1, ASTM E164, ASME Section V.
   c) Magnetic Particle Testing ASTM E109, ASME Section V.
   d) Penetrant Testing - ASTM E165, ASME Section V.

SECTION 12

SPRAY-APPLIED FIRE-RESISTIVE MATERIALS

OBJECTIVE

The purpose of spray-applied fire-resistive materials observation is to verify that the application of material is in accordance with the project specifications, applicable codes, and manufacturer's recommendations.

This objective can best be achieved by experienced special inspectors who diligently perform the duties listed below while under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and manufacturer's recommendations.
2. Review applicable sections of referenced codes and standards.

B. Observation Procedures

1. Verify substrate condition for cleanliness prior to application.
2. Verify application in accordance with code and specifications.

C. Testing and Sampling Duties

1. Measure thickness of spray-applied fire-resistive material in accordance with specifications and Uniform Building Code Standard 7-6.
2. Remove and deliver samples to materials engineering laboratory for unit weight tests.
3. Reinspect areas repaired due to insufficient thickness or damage by sampling, tenant improvements, panel placement, rain, etc.

D. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 13

GLU LAM AND TRUSS JOISTS

OBJECTIVE

The fabrication of most glu lam and truss joist products is conducted in controlled plant conditions which are designed for a mass-produced product. The primary purpose of observing the product at the plant is to check the critical operations, such as gluing, and to provide verification that the quality control exercised by the fabricator is adequate.

To best achieve this objective, an experienced timber technician should be employed performing the following duties under the direct control of the materials engineering laboratory.

GLU LAM TIMBER OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and approved shop drawings.
2. Review applicable sections of referenced codes, particularly the Timber Construction Manual by the American Institute of Timber Construction (AITC) and reference standards of the Uniform Building Code by ICBO.
3. Verify that the proposed lumber grades, combinations, adhesive, and end joint details meet with code requirements.

B. Materials

1. Verify certifications on lumber grading, adhesives, and preservatives.
2. Verify lumber grade marks on the pieces being used.

C. Observation Requirements - Preliminary

1. Verify that shop drawings have been reviewed and stamped by Architect/Engineer and General Contractor.
2. Verify that spacing of joints meets job and code requirements.
3. Measure moisture content of lumber and verify with acceptance range specified.
4. Check appearance grade requirements.
5. Verify preservative treatment requirements.

D. Observation of Sub-Assemblies (End Joints)

1. Verify lumber grade at end joints.
2. Gluing and curing procedure, verification of following:
   a) Lumber moisture, temperature, and cross-section
   b) Workroom humidity and temperature
   c) Adhesive certification, lot, and temperature
   d) Joint match and separation
   e) Assembly temperature, pressure, and time
   f) Sample and test representative joints

E. Laminating (Gluing)

1. Recheck lumber grades, combinations and faces, moisture, and temperature.
2. Record workroom temperature and humidity.
3. Adhesive certification, lot verification, and temperature.
4. Verify camber assembly.
5. Gluing and curing:
   a) Observe glue spread and check for skips.
   b) Record open time prior to clamping.
   c) Record clamping pressure.
   d) Record curing temperature and time.
   e) Sample and test (block shear, core shear, cyclic delamination).

F. Finishing

1. Recheck joint spacing and cross-sectional dimensions.
2. Observe repairs for appearance.
3. Record and inspect surface treatment.
   a) Preservative
   b) Sealer
   c) Primer or paint
4. Hammer-brand each member, prepare shipping certificate.
5. Observe and record wrapping.

G. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

TRUSS-TYPE JOIST CONSTRUCTION

A. Chord Fabrication

1. Perform all requirements of "Glu Lam Timber Observation Duties".
2. Check end joint spacing at panel points.
3. Check drilling and routing for webs.

B. Web Fabrication

1. Structural Steel:
   a) Review specification requirements.
   b) Review mill certification, steel, and coating.
   c) Sample and test, when specified.
2. Fabrication:
   a) Verify web wall thicknesses and diameters at specified locations.
   b) Check for splitting at flattened ends.
   c) Check alignment edge distance and pin placement.
   d) Check bridging clips, bearing clips, and ridge connector.
   e) Check truss dimensions.
   f) Check connector welding, if performed.

C. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

SECTION 14

SHEAR WALLS AND FLOOR SYSTEMS USED AS SHEAR DIAPHRAGMS

OBJECTIVE

Many public agencies are now requiring special inspection during the construction of plywood shear walls and floor systems used as shear diaphragms. These are critically important elements to the structural integrity of the building, and are therefore considered appropriate for special inspection.

This objective can best be achieved by qualified special inspectors performing the following duties under the direct supervision of the materials engineering laboratory.

OBSERVATION DUTIES

A. Documents

1. Review the approved plans, specifications, and other appropriate project documents.
2. Review applicable sections of referenced codes and standards, particularly the Timber Construction Manual by the American Institute of Timber Construction (AITC) and the Uniform Building Code by ICBO.

B. Materials

1. Verify material grades.
2. Verify nail type and size.
3. Verify connector, including tiedowns, framing clips, bolts, and straps.

C. Sampling of Materials

1. Sample and deliver to the laboratory for testing the following materials when required by project specifications:
   a) Structural panel sheathing (i.e. plywood, gypsum, fiberboard or particle board)
   b) Framing lumber
   c) Fasteners including nails, screws, bolts, etc.

D. Observations Procedures

1. Check nail spacing, penetration, edge distance, and verify nail size.
2. Check for proper plywood thickness and grade.
3. Check for installation of blocking, when blocked edges are required.
4. Check the receiving members for spacing, size, and resistance to splitting.
5. Check for proper plywood layout per project requirements.
6. Check for “shiners” (nails penetrating structural panel sheathing only).
7. Verify that critical members have received the nail specified.

E. Reports

1. Submit written progress reports describing the tests and observations made and showing the action taken to correct nonconforming work. Itemize any changes authorized by architect/engineer. Report all uncorrected deviations from plans or specifications.

STRUCTURAL TESTS AND INSPECTION SCHEDULE

(See Appendix A on Opposite Page for requirements of Uniform Building Code, Section 1701)

Prior to the acceptance of a building permit, the Owner, on the advice of the Architect or Engineer, shall complete, sign and submit this form to the Building Official.

_____ _____

Project Name Date

_____ _____

Project Address Testing/Inspection Agency

_____ _____

Owner's Name Signature & Title

hereby certifies that the Testing/Inspection Agency named above has been engaged to perform structural tests and inspection during construction, as checked below, to satisfy all applicable portions of the Building Code.

Prior to issuance of an occupancy permit, the Inspection Agency shall submit a statement that all items of designated work performed were reported. Any items checked but not tested or inspected will be noted and explained.

Whenever any designated items on this list are ready for sampling, testing, or inspection, it shall be the responsibility of the Contractor to give timely notice to the Inspection Agency so that the required services may be performed.

REINFORCING STEEL:
- _____ Tensile & Bend, one set per heat per _____ tons
- _____ Inspection of Placement
- _____ Inspection of Welding

MASONRY:
- _____ Preliminary Acceptance Tests (Masonry Units, Wall Prisms)
- _____ Subsequent Tests (Mortar, Grout, Field Wall Prisms)
- _____ Inspection of Grouting
- _____ Inspection of Placement & Grouting

CONCRETE, SHOTCRETE GROUT & MORTAR

Conc.	Shot.	Grout.	Mortar	
				Aggregate Tests for Designs
				Suitability of Aggregates
				Mix Designs
				Test Panel
				Batch Plant Inspection
				Cement Grab Sample
				Inspect Placing
				Compression Tests
				Cast Specimens
				Pick-Up Samples
				Shrinkage Bars
				Yield Check
				Air Check
				Dry Unit Weight

PRECAST/POST-TENSIONED CONCRETE:
- _____ Reinforcing Tests
- _____ Inspection of Reinforcing Placement
- _____ Tendon Tests
- _____ Inspection of Tendon Placement
- _____ Inspection of Concrete Placement
- _____ Inspection of Concrete Batching
- _____ Inspection of Panel Attachments & Inserts
- _____ Inspection of Panel Installation
- _____ Compression Tests
- _____ Inspection of Stressing/Transfer

PILING, CAISSONS, CAPS, TIES:
- _____ Inspection of Reinforcing Placement
- _____ Inspection of Concrete Placement
- _____ Inspection of Concrete Batching

UNDERPINNING:
- _____ Inspection of Steel Fabrication
- _____ Inspection of Reinforcing & Forms
- _____ Inspection of concrete Placement
- _____ Inspection of Tiebacks

STRUCTURAL STEEL:
- _____ Sample & Test (list specific members below)
- _____ Shop Identification & Welding Inspection
- _____ Shop Ultrasonic Inspection
- _____ Shop Radiography
- _____ Field Welding Inspection
- _____ Field Bolting Inspection
- _____ Filed Ultrasonic Inspection
- _____ Field Radiography
- _____ Metal Deck Welding Inspection

ASPHALTIC CONCRETE:
- _____ Mix Designs
- _____ Inspection of Batch Plant
- _____ Core/Test
- _____ Field Inspection
- _____ Suitability Tests
  - _____ Specific Gravity
  - _____ Asphalt Content
  - _____ Sieve Analysis
  - _____ K Factors
  - _____ Stabilometer Value
  - _____ Swell

INSULATING CONCRETE:
- _____ Sample & Test
- _____ Unit Weights

FIREPROOFING:
- _____ Inspection of Placement
- _____ Density Tests
- _____ Thickness Tests
- _____ Inspect Batching

FILL MATERIAL:
- _____ Acceptance Tests
- _____ Moisture-Density Determination
- _____ Field Density

ROOFING:
- _____ Inspection of Placement
- _____ Sample & Test

STRUCTURAL WOOD:
- _____ Inspection of Fabrication
- _____ Inspection of Truss Joist Fabrication
- _____ Sample & Test Components
- _____ Inspection of Glu Lam Fabrication
- _____ Shear Diaphragms

Other Tests, Inspections or Special Instructions

APPENDIX A

All of the test and inspection listed on the STRUCTURAL TESTS AND INSPECTION SCHEDULE will be called for at one time or another in the plans and specifications submitted to a Building Department. Seldom will one project require all of the tests and inspections shown. The listed items fall into one of the following categories:

1. Required by plans and specifications as deemed necessary by the Architect/Engineer for the integrity and successful performance of the project.
2. Required by specific reference in the Uniform Building Code, 1997 Edition.
3. A combination of 1 and 2.

The following lists the Building Code references which bear on each of the tests and inspections in the STRUCTURAL TESTS AND INSPECTION SCHEDULE. Where no Building Code Section is cited, the test or inspection is optional at the discretion of the Architect/Engineer.

REINFORCING STEEL
Tensile and Bend Test – 1903.5
Inspection of Placement – 1701.5(4)
Inspection of Welding – 1701.5(5.3)

MASONRY
Preliminary Tests (Masonry Units, Wall Prisms) – 2105.3(2), UBC Standard 21-17
Subsequent Tests (Mortar, Grout, Field Wall Prisms) -2105.3(2-5)
Requirements for Grouting – 2104.6
Inspection of Masonry Placement and Grouting – 1701.5(7), 2104.1-8, 2105.1-5, Table 21A, Table 21B, Table 21C

CONCRETE, SHOTCRETE, GROUT &MORTAR

CONCRETE	SHOTCRETE	GROUT	MORTAR	
1903.1				Agg. Tests for Designs
1903.3	1924	2102.2	2102.2	Suitability of Agg.
1905.1	1924.2	Table 21B	Table 21A	Mix Designs
	1924.5			Test Panel
				Batch Plant Inspection
				Cement Grab Sample
1701.5	1701.5(12)	1701.5.7	1701.5.7	Inspect Placing
1904.6	1924.10	STD 21-18	STDS 21-15,16 & 17	Compression Tests
1905.6	1924.10	STD 21-18	STDS 21-15 & 17	Cast Specimens
				Pick-Up Samples
				Shrinkage Bars
				Yield Check
				Air Check
				Dry Unit Weight

PRECAST/POST-TENSIONED CONCRETE
Reinforcing Tests (see Reinforcing Steel)
Inspection of Reinforcing Placement – 1701.5(4)
Tendon Requirements – 1903.5(5)
Inspection of Tendon Placement – 1701.5(4)
Inspection of Concrete Placement – 1701.5(1)
Inspection of Concrete Batching – ASTM C-94
Inspection of Panel Attach and Inserts – 1701.5(1)
Inspection of Panel Installation – 1701.5(1)
Compression Tests – 1905.6
Inspection of Stressing – 1701.5(4)

PILING, CAISSONS, CAPS, TIES
Inspection of reinforcing Placement – 1701.5(4)
Inspection of Concrete Placement – 1701.5(1)
Inspection of Concrete Batching – ASTM C-94

UNDERPINNING
Inspection of Steel Fabrication – 1701.5(5)
Inspection of Reinforcing and Forms – 1701.5(4)
Inspection of Concrete Placement – 1701.5(1)

STRUCTURAL STEEL
Material Standards - UBC STD 22-1
Material Standards Indentification – 2203
Welding – 2205.10
Shop and Field Ultrasonic Testing – 1703
Shop and Field Radiographic Testing – 1703
Field Welding – 1701.5(5), Chapter 22
Field Bolting – 1701.5(6), Chapter 22
Metal Deck Welding – 1701.5(5)

STRUCTURAL WOOD
Inspection of Fabrication – ANSI/AITC A1901.1
Sample and Test Components – ANSI/AITC A1901.1
Shear Diaphragms – 2315

GUIDELINES FOR ISSUING IDENTIFICATION CARDS FOR SPECIAL INSPECTORS

INTRODUCTION

Background

In the interest of uniformity of enforcement of the Uniform Building Code (UBC) Section 1701 (Special Inspection) requirements, as well as uniformity of qualifications of personnel to perform those functions, it became necessary to establish minimum standards for inspectors performing "special inspection" as defined in UBC.

The California Council of Testing and Inspection Agencies (CCTIA), a non-profit professional association of testing and inspection companies, was formed for the specific purpose of engendering uniformity in code enforcement inspection activities. CCTIA recommends the following as minimum standards. These standards are based on consensus deliberations as to the qualifications necessary to satisfactorily perform the duties prescribed by UBC.

Definition

"SPECIAL INSPECTOR" [Reference UBC Section 1701.2]
The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the building official, for inspection of the particular type of construction or operation requiring special inspection.

Identification

In order to ensure uniformity of inspector qualifications in a manner that would be verifiable by the Public Agency Building Official, the minimum qualification standards will become the basis for issuing identification cards for Special Inspectors.

OBJECTIVE

To institute a standard for minimum inspector qualifications which will serve as a guideline for issuing, in a controlled manner, official identification cards to Special Inspector(s) by the respective testing and inspection agency(ies).

A. General Requirements

1. Identification card (similar to sample on following page) must be signed by a Professional Engineer who is a full-time employee of an approved testing/inspection agency that complies with ASTM E329. Inspector must be an employee of the testing/inspection agency that issued the identification card.
2. Inspector shall have demonstrated ability to read plans and specifications commensurate with inspection duties.
3. Inspector shall be knowledgeable of the Uniform Building Code (UBC) and applicable Standards (i.e. American Concrete Institute [ACI], American Welding Society [AWS], etc.
4. The Special Inspector shall observe the work assigned for conformance with the approved design drawings and specifications, and other approved documents.
5. The Special Inspector shall furnish inspection reports, when requested, to the building official, the engineer or architect of record, and other designated persons. All discrepancies shall be brought to the immediate attention of the contractor for correction; then, if uncorrected, to the proper design authority and to the building official.
6. The Special Inspector shall report whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with the approved plans and specifications and the applicable workmanship provision of UBC.
7. Special inspection shall not be relied upon by others as acceptance of work, nor shall it in any manner relieve any contractor, or any other party, from their obligations and responsibilities under the construction contract, or generally accepted industry custom.

B. Experience

1. In order for experience to count toward qualification, it must be based on verifiable work directly related to the category or type of inspection involved.
2. An engineering degree (BS) plus appropriate in-house training may be substituted for not more than one year of experience. An engineering technology degree (AA) plus appropriate in-house training may be substituted for not more than six months experience.
3. Five or more years experience as a qualified Special Inspector in one or more categories of work may fulfill up to half of the experience requirements in any category, at the discretion of the Responsible Professional Engineer.

C. Certification

1. Certification, when specified, is intended to mean successful completion of an examination appropriate to the category of work involved and in accordance with the requirements of the certifying agency.

D. Special Inspector in Training

1. The intent of this provision is to provide practical opportunities for an inspector to gain the needed experience to qualify as a Special Inspector.
2. An inspector who does not meet the qualifications for Special Inspector may be allowed to perform "Special Inspection", at the discretion of the Responsible Professional Engineer, provided one or more of the following conditions are met:
   (a) Individual is working under direct and continuous supervision of a Special Inspector fully qualified for the type of work involved.
   (b) Individual is working under indirect or periodic supervision of a Special Inspector and the scope of work is minor and/or routine and within the capabilities of the individual.
   (c) Individual is specifically approved by the Building Official.

E. Minimum Qualifications for Work Categories of the "Special Inspector"

1. Reinforced Concrete
   (a) Minimum one year experience, and
   (b) Certification by ACI (Grade 1), and
   (c) Certification in this Category.
2. Ductile Concrete

(a) Minimum six months experience plus three years experience in Category 1, and
(b) Certification in Category 1.

3. Prestressed Concrete
   (a) Minimum six months plus three years experience in Category 1, and
   (b) Certification by ACI (Grade 1), and
   (c) Certification in this Category.
4. Shotcrete
   (a) Minimum three months experience, and
   (b) Certification in Category 1.
5. Welding
   (a) Minimum three years experience, and
   (b) Certification in this Category.
6. NDT (Structural Steel)
   (a) Experience per ASNT-TC-1A guidelines
7. High Strength Bolting
   (a) Minimum six months experience, or
   (b) Qualified in Category 5.
8. Structural Masonry
   (a) Minimum one year experience, or six months plus qualified in
   (b) Category 1, and
   (c) Certification in this Category.

9 Reinforced Gypsum and Insulating Concrete
   (a) Qualified in Category 1.

10. Spray-Applied Fire-resistive materials
    (a) Minimum six months experience, or three months plus qualified in Category 1 or 5,
    (b) Certification in this Category.
11. Piling, Drilled Piers and Caissons
    (a) Concrete Work
        (1) Qualified in Category 1.
    (b) Soil Work
        (1) Qualified in Category 12.
12. Soils and Earthwork (Special Grading, Excavation and Filling)
    (a) Minimum three years experience,
    (b) Certification optional.
13. Structural Wood and Glu Lam
    (a) Minimum two years experience,
    (b) Certification optional.
14. Asphaltic Concrete
    (a) Minimum one year experience,
    (b) Certification optional.
15. Roofing
    (a) Minimum one year experience,
    (b) Certification optional
16. Field Sampling and Field Testing in Any Category
    (a) Minimum three months experience,
    (b) Certification by ACI (Grade 1) required for concrete.
17. Special Inspector in Training
    (a) In training for experience, and
    (b) No certifications required.

F. Reference Abbreviations & Recognized Certifying Agencies

1.	AA	Associate of Arts
2.	ACI	American Concrete Institute
3.	ACIA	American Construction Inspectors Association
4.	ASTM	American Society for Testing and Materials
5.	ASNT	American Society for Nondestructive Testing
6.	AWS/ACWI	American Welding Society/Associate Certified Welding Inspector
7.	AWS/CWI	American Welding Society/Certified Welding Inspector
8.	BS	Bachelor of Science
9.	ICBO	International Conference of Building Officials
10.	NICET	National Institute for Certification of Engineering Technologists
11.	NRCA	National Roofing Contractors Association
12.	DSA/ORS	Division of the State Architect/Office of Regulation Services
13.	OSHPD	Office of Statewide Health Planning and Development
14.	UBC	Uniform Building Code

SAMPLE ID CARD

Front

Skyline Testing Laboratory

Member of CCTIA

EMPLOYEE IDENTIFICATION CARD

Control No. _____

This is to certify that

_____

is duly qualified to perform the duties of special inspector as indicated on the reverse of side of this card.

Expiration date: _____

_____

Authorized Professional Engineer's Signature

Skyline Testing Laboratory
1234 Main Street
Anytown, California 90000-0000

Back

____REINFORCED CONCRETE	____REINFORCED GYPSUM
____DUCTILE CONCRETE	____FIREPROOFING
____PRESTRESSED CONCRETE	____PILING AND DRILLED PIERS
____SHOTCRETE	____SOILS AND EARTHWORK
____WELDING	____STRUCTURAL WOOD
____NDT (STRUCTURAL STEEL)	____ASPHALTIC CONCRETE
____HIGH STRENGTH BOLTING	____ROOFING
____STRUCTURAL MASONRY	____FIELD SAMPLING

CALIFORNIA COUNCIL OF TESTING AND INSPECTION AGENCIES

Additional copies of the Guideline may be requested at no cost from any CCTIA member agency