5. POST-EARTHQUAKE INSPECTION

Post-earthquake inspection is that part of the post-earthquake evaluation process that is conducted at the building. It includes detailed visual observation of the condition of the entire structure as well as selected individual connections and elements. Visual observation is the primary tool for determining the damage sustained by the structure. It should be supplemented by non-destructive testing techniques as required to detect damage that is not directly observable.

The moment-resisting connections to be inspected should be determined in accordance with Chapter 4. In addition, other potentially vulnerable connections should also be inspected, particularly when evidence of damage is found in the observation of overall building condition, or in the inspection of moment-resisting connections.

Inspection should be conducted under the supervision of a structural engineer familiar with the issues involved. When lower tier personnel are used to perform the inspections, the structural engineer should ascertain that they have adequate knowledge of the types of damage likely to be encountered, and the indicators as to its existence.

Careful recording and reporting of the results of inspections is critical to the process. Damage should be reported using the standard classification system of Section 3.1. Care must be taken to accurately report the location as well as the type and degree of damage, and since damage can increase as the building is subjected to additional loads, the date at which observations were made.

When required by the building official, or recommended by the Interim Guidelines in Chapter 4, post-earthquake inspections of buildings may be conducted in accordance with the Interim Guidelines of this Chapter. An appropriate sample (or samples) of WSMF connections should be selected for inspection in accordance with the Chapter 4 Guidelines. These connections, and others deemed appropriate by the engineer, should be subjected to visual inspection (VI) and non-destructive testing (NDT) as required by this Chapter.

5.1 Connection Types Requiring Inspection

5.1.1 Welded Steel Moment Frame (WSMF) Connections

The inspection of a WSMF connection should include the complete joint penetration (CJP) groove welds connecting both top and bottom beam flanges to the column flange, including the backing bar and the weld access holes in the beam web; the shear tab connection, including the bolts, supplemental welds and beam web; the column's web panel zone, including doubler plates; and the continuity plates and continuity plate welds (See Figure 3-1).

Commentary: The largest concentration of reported damage following the Northridge Earthquake occurred at the welded joint between the bottom girder *flange and column, or in the immediate vicinity of this joint. To a much lesser extent, damage was also observed in some buildings at the joint between the top girder flange and column. If damage at either of these locations is substantial (d_j per Chapter 4 greater than 5) then damage is also commonly found in the panel zone or shear tab areas.*

These Interim Guidelines recommend complete inspection, by visual and NDT assisted means, of all of these potential damage areas for a small representative sample of connections. This practice is consistent with that followed by most engineers in the Los Angeles area, following the Northridge Earthquake. It requires removal of fireproofing from a relatively large surface of the steel framing, which at most connections will be undamaged.

Some engineers have suggested an alternative approach consisting of visual - only inspections, limited to the girder bottom flange to column joint, but for a very large percentage of the total connections in the building. These bottom flange joint connections can be visually inspected with much less fireproofing removed from the framing surfaces. When significant damage is found at the exposed bottom connection, then additional fireproofing is removed to allow full exposure of the connection and inspection of the remaining surfaces. These engineers feel that by inspecting more connections, albeit to a lesser scope than recommended in these Interim Guidelines, their ability to locate the most severe occurrences of damage in a building is enhanced. These engineers use NDT assisted inspection on a very small sample of the total connections exposed to obtain an indication of the likelihood of hidden problems including damage types.

If properly executed, such an approach can provide sufficient information to evaluate the post-earthquake condition of a building and to make appropriate occupancy, structural repair and/or modification decisions. It is important that the visual inspector be highly trained and that visual inspections be carefully performed, preferably by a structural engineer. Casual observation may miss clues that hidden damage exists. If, as a result of the partial visual inspection, there is any reason to believe that damage exists at a connection (such as small gaps between the CJP weld backing and column face), then complete inspection of the suspected connection, in accordance with the recommendations of these Interim Guidelines should be performed. If this approach is followed, it is recommended that a significantly larger sample of connections than otherwise recommended by these Interim Guidelines, perhaps nearly all of the connections, be inspected.

5.1.2 Gravity Connections

In addition to the sample of moment-resisting connections recommended for inspection in Chapter 4, it may be appropriate to inspect selected gravity connections. These include gravity connections for:

1. beams framing orthogonally into a WSMF within the zone of influence of particular WSMF connections with significant damage, and

2. beams framing parallel to a WSMF where significant permanent drift has occurred.

Inspection should include any shear tabs, clip angles, or similar elements and the welds and/or bolts attaching these elements to the beam and supporting framing member.

Commentary: If little or no damage is found to the moment-resisting connections in a building, it is probable that the gravity connections have not sustained any significant damage. However, if substantial damage is found to moment-resisting connections, some inspection of the gravity connections in the zone of influence of the more heavily damaged moment-resisting connections is probably warranted. For beams framing orthogonally into a WSMF, the zone of influence includes those beams framing directly into columns with damaged connections, as shown in Figures 4-1 and 4-2. It also includes any other beams that could have experienced large torsional rotations as a result of flexural rotations experienced by the WSMF members they frame to. For beams aligned parallel with the WSMF, this zone of influence includes any portion of the structure likely to have experienced excessive drift, as indicated by the damaged moment connection.

5.1.3 Other Connection Types

The structural engineer should review the need to inspect a representative sample of other connection types that exhibit negative attributes similar to the CJP beam-to-column weld configuration.

Commentary: These negative attributes include: the inherent residual stress concentrations caused by the welding sequence of highly restrained CJP groove welds used to connect WSMF beams and columns, and the particular care required during their execution to ensure that the welds have no material defects; the post-yield straining in the through-thickness direction of CJP welds used to join WSMF beams and columns; the post-yield straining in the through-thickness direction of WSMF column flanges in a tri-axial state of stress; the difficulty of executing the WSMF beam's bottom flange CJP weld through the restriction created by the web access hole; and the potential for creating a stress riser by leaving the steel backing (backing bar) in place after completing the CJP weld. Connections that are potential high priority candidates for inspection because of their similar connection and stiffness configuration, and because of their use of *highly restrained CJP welds include certain eccentric braced frame (EBF) configurations, column-to-base plate connections, and certain drag and collector elements.*

In addition, selected column splices located such that stresses on the weld during the earthquake response likely approached the minimum specified yield strength should be inspected, including complete joint penetration welded splices in Group 4 and 5 shapes and partial penetration groove welded joints for all shape groups. Complete joint penetration flange welds in Group 4 and 5 Sections have demonstrated a vulnerability to brittle fracture under gravity load conditions. Partial joint penetration groove welds have an inherent "notch" or stress-riser condition which can serve as the initiation point for fracture under conditions of high tensile stress demands.

5.2 Preparation

5.2.1 Preliminary Document Review and Evaluation

5.2.1.1 Document Collection and Review

Prior to performing an inspection, the original construction drawings should be reviewed (if available) to identify the primary lateral and gravity load-resisting systems, typical detailing, presence of irregularities, etc. Pertinent available engineering and geotechnical reports, including previous damage survey reports and current ground motion estimates should also be reviewed. Specifications (including the original Welding Procedure Specifications), shop drawings, erection drawings, and construction records need not be reviewed.

5.2.1.2 Preliminary Building Walk-Through.

A walk-through should be conducted to note visible structural and nonstructural damage, deviations from the plans, and other conditions not evident from the document review.

Commentary: If a preliminary post-earthquake evaluation has not previously been conducted, one should be performed at this time. A preliminary post-earthquake evaluation based on ATC-20 (Applied Technology Council - 1989), or a similar standard, will not necessarily indicate that damage has been sustained.

5.2.1.3 Structural Analysis

A detailed structural analysis of the building need not be performed prior to performing building inspections. At the engineer's discretion, such analyses may be performed, in order to develop an understanding as to which connections in the building are most critical and to the extent possible, an understanding of where damage may have concentrated. Analyses used for this purpose should be based on rational principles of engineering mechanics and to the extent possible, should use an actual representation of the ground motion experienced by the building.

Commentary: Detailed analytical studies of buildings damaged by the Northridge Earthquake indicated some correlation between the actual occurrence of damage and predicted connections with high demands. However, this correlation was not large enough to warrant strong recommendations that analyses be performed prior to performing inspections. In fact, these analyses showed that it is important to inspect connections throughout the structure, regardless of the demands predicted by analysis. The Interim Guidelines for selecting a representative sample of connections for inspection, presented in Chapter 4, contain two methods, A and B, which do not require any prior analysis of the structure, other than to identify its structural system and the location of moment-resisting connections. Some engineers may feel that structural analyses are beneficial in developing a program of inspection, and will prefer to select a sample of connections for inspection based on such analyses. Sample selection Method C, in Chapter 4, is provided for engineers who prefer such an approach.

Any rational method of analysis, including linear static, linear dynamic and nonlinear methods may be utilized. When performing dynamic analyses, it is important to use a representation of the ground motion that reasonably resembles that likely to have been experienced by the building, as opposed to a general smoothed response spectrum. The sharp peaks of response which occur over narrow bands of frequencies in actual ground motion recordings can accentuate higher mode response in some buildings, which may not be adequately detected using generic smoothed spectra. Analyses of the response of taller buildings affected by the Northridge Earthquake, as well as their damage patterns, suggest that higher mode effects had a significant impact on the locations of severe strength and deformation demands, as well as damage.

The most reliable method of obtaining a representative ground motion is to use data directly recorded by instrumentation at the building site or a nearby site. Instruments located more than 1 km from the building site, or on sites with significantly different subsoil conditions should not be considered particularly representative. Seismologists have the capability to generate estimates of ground motion using fault rupture simulation and wave propagation modeling techniques that may be useful for these purposes as well. However, the engineer should be advised that great uncertainty is associated with such techniques and ground motion representations generated in this manner are only estimates.

5.2.1.4 Vertical Plumbness Check

A rigorous vertical plumbness check is not necessary unless signs of a permanent lateral drift (e.g., elevators are not functioning, door jambs are distorted, or the building is visibly tilted) are observed at one or more floors. In such cases, a vertical plumbness check should be conducted by a licensed Surveyor to determine the extent that the post-earthquake out-of-plumbness exceeds AISC Frame Tolerances as defined in the AISC Code of Standard Practice Section 7.11. If significant permanent lateral drift is determined to exist, the structural engineer should determine whether or not this drift, when superimposed with the postulated drift from a future earthquake, presents unacceptable P-Δ stress effects.

Commentary: When the plumbness check is deemed advisable, preliminary checks can conveniently be made by the engineer from the interior of the building, through the elevator shaft with the use of a plumb bob as elevator appurtenances, such as sill plates on doors are typically constructed in close vertical alignment. When a more accurate evaluation of plumbness is required, surveying measurements should be made at each exterior principal corner of the building..

5.2.2 Connection Exposure

Pre-inspection activities to expose and prepare a connection for inspection should include the local removal of suspended ceiling panels or (as applicable) local demolition of permanent ceiling finish to access the connection; and cleaning of the column panel zone, the column flange, continuity plates, beam web and flanges. The extent of the removal of fireproofing should be sufficient to allow adequate inspection of the surfaces to be inspected. Figure 5-1 suggests a pattern that will allow both visual and NDT inspection of the top and bottom beam flange to column joints, the beam web and shear connection, column panel zone and continuity plates, and column flanges in the areas of highest expected demands. The maximum extent of the removal of fireproofing need not be greater than a distance equal to the beam depth "d" into the beam span to expose evidence of any yielding.

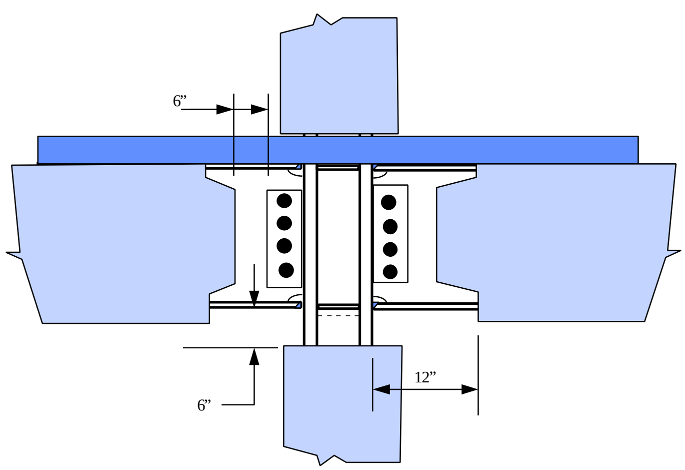

Figure 5-1 Recommended Zone for Removal of Fireproofing

Commentary: Cleaning of weld areas and removal of mill scale and weld spatter should be done with care, preferably using a power wire brush, to ensure a clean surface that does not affect the accuracy of ultrasonic testing. The resulting surface finish should be clean, free of mill scale, rust and foreign matter. The use of a chisel should be avoided to preclude scratching the steel surfaces which could be mistaken for yield lines. Sprayed-on fireproofing on WSMFs erected prior to about 1980 is likely to contain asbestos and should be handled according to applicable standards for the removal of hazardous materials. To preclude physical exposure to hazardous materials and working conditions, the structural engineer should require by contractual agreement with the building owner, prior to the start of the inspection program, that the building owner deliver to the structural engineer for his/her review and files a laboratory certificate that confirms the absence of asbestos in structural steel fireproofing, local pipe insulation, ceiling tiles, and drywall joint compound.

The pattern of fireproofing removal indicated in Figure 5-1 is adequate to allow visual and UT inspection of the top and bottom girder flange to column joints, the beam web and shear connection and the column panel zone. As discussed in the commentary to Section 5.1.1, some engineers prefer to initially inspect only the bottom beam flange to column joint. In such cases, the initial removal of fireproofing can be more limited than indicated in the figure. If after initial inspection, damage at a connection is suspected, then full removal, as indicated in the figure, should be performed to allow inspection of all areas of the connection.

5.3 Inspection Program

5.3.1 Visual Inspection (VI)

Visual Inspection is the primary means of determining the condition of the structure. It should be performed by, or under the direction of, a structural engineer, and in as many locations as is practical. As a minimum, it should be performed in those locations selected in accordance with one of the methods of Chapter 4. It may be performed and documented by other competent persons, but should be performed with a structural engineer's written instructions and guidance. When VI is performed by a testing agency, the agency and personnel performing the work should conform to the Interim Guidelines of Chapter 10. As a minimum, the structural engineer in charge should visit the site as needed during the performance of visual inspection to confirm that his/her instructions are understood and followed, and to provide a spot check of the adequacy of surface preparation of the connection for VI and NDT, that the recorded locations of damage are correct, and that damage is accurately reported.

The presence or absence of damage should be recorded in a consistent and objective manner on a uniform data sheet that will allow later interpretation of the conditions and assessment of its severity and the types of repair which may be warranted. Severe damage should be documented with photographs. Data sheets should include a sketch of the connection and locations of any significant non-conforming or damage conditions noted. Damage should be classified in accordance with the system indicated in Section 3.1.

Commentary: The presence or absence of the following conditions should be recorded for each inspected connection:

a) Deviations from Construction Documents or Specifications.

b) Continuity plates.

c) Doubler plates (on one or both sides of the web).

d) Supplemental web welds (from beam-web-to-shear-tab).

e) Flange weld backing bar and runoff tabs.

f) Flange weld end dams.

g) Poor Fit-up of backing bar.

h) Evidence of weld spatter (<u>must</u> be removed <u>prior</u> to performing Ultrasonic Testing).

i) Smooth (or rough) beam web cope for weld access holes.

j) Evidence of poor quality welding workmanship per AWS D1.1 Section 6.5.1 and 8.15.1.

k) Undercut, underfill or excessive concavity/convexity of welds.

l) Undersized fillet welds.

The presence or absence of damage should be recorded. For purposes of visual inspection, backing bars need not be removed. If damage is discovered, it should be recorded by type, per the classification system of Chapter 3.

When full inspection of a connection is conducted, both sides of the beam, column, and panel zone should be inspected. If one side of the connection is obstructed (e.g., by exterior walls), such obstructions need not be removed if the accessible side of the connection appears undamaged. Beam top flange connection welds may be inspected without local removal of the floor diaphragm finish if there is no apparent significant damage at the bottom beam flange, adjacent column flange, column web, or shear connection. If severe beam bottom flange damage is observed, removal of diaphragm materials to allow direct observation of the beam top flange is recommended. More information on VI may be found in AWS B1.11.

5.3.1.1 Top Flange

The exposed root of this "T" joint should be inspected to note any possible separation of the edge of the backup bar from the face of the column flange. The exposed surface of the beam flange and column flange should be observed to note any cracks which may have occurred. Beam flange base metal at the intersection of the weld access hole in the web to the beam flange should be inspected to note any visible cracks.

5.3.1.2 Bottom Flange

The possible separation of the backup bar to column flange should be inspected as above. The face of the weld should be inspected to note any possible cracks in the weld, the toe of the weld or in the adjacent base metal. The base metal of the column flange above, below and each side of the intersecting beam flange should be inspected to note any possible visible cracks as should the beam flange in the vicinity of the web access hole, as above.

5.3.1.3 Column and Continuity Plates

Column base metal and the continuity plates and their welds to the inside face of the column flanges should be visually inspected. The column web above and below the continuity plate should be inspected to note any visible cracks.

5.3.1.4 Beam Web Shear Connection

The shear connection plate, beam web, and corresponding bolts should be inspected to note any possible rotation. The base metal around the bolt head and nut including washers if used, may show signs of bright metal if rotation has occurred. Observation should include examination for bolts which may have loosened as well as any welds used in combination with the bolted connection. The exposed surface of the shear plate to column flange weld should be visually inspected with primary attention being paid to the termination of this weld near the beam's bottom flange.

5.3.2 Nondestructive Testing (NDT)

NDT should be used to supplement the visual inspection of connections selected in accordance with the Interim Guidelines of Chapter 4. The testing agency and NDT personnel performing this work should conform to the qualifications indicated in Chapter 11 of these Interim Guidelines. The following NDT techniques should be used at the top and bottom of each connection, where accessible, to supplement visual inspection:

a) Magnetic particle testing (MT) of the beam flange - to column flange weld surfaces. All surfaces which were visually inspected should be tested using the magnetic particle technique.

   Commentary: The color of powder should be selected to achieve maximum contrast to the base and weld metal under examination. The test may be further enhanced by applying a white coating made specifically for MT or by applying penetrant developer prior to the MT examination. This background coating should be allowed to thoroughly dry before performing the MT.

b) Ultrasonic testing (UT) of all faces at the beam flange welds and adjacent column flanges (extending at least 3 inches above and below the location of the CJP weld, along the face of the column, but not less than 1-1/2 times the column flange thickness).

Commentary: The purpose of UT is to 1) locate and describe the extent of internal defects not visible on the surface and 2) to determine the extent of cracks observed visually and by MT.

Requirements and acceptance criteria for NDT should be as given in AWS D1.1 Sections 6 and 8. Acceptance or rejection of planar weld discontinuity (cracks, slag inclusion, or lack of fusion), including root indications, should, as a minimum, be consistent with AWS Discontinuities Severity Class designations of cracks and defects per Table 8.2 of AWS D1.1 for Static Structures. Beam flange welds should be tested as "tension welds" per AWS D1.1 Table 8.15.3, Note 3. Backing bars need not be removed prior to performing UT.

Commentary: The value of UT for locating small discontinuities at the root of beam flange to column flange welds when the backing is left in place is not universally accepted. The reliability of this technique is particularly questionable at the center of the joint, where the beam web obscures the signal. There have been a number of reported instances of UT detected indications which were not found upon removal of the backing, and similarly, there have been reported instances of defects which were missed by UT examination but were evident upon removal of the backing. The smaller the defect, the less likely it is that UT alone will reliably detect its presence.

Despite the potential inaccuracies of this technique, it is the only method currently available, short of removal of the backing, to find subsurface damage in the welds. It is also the most reliable method for finding lamellar problems in the column flange (type C4 and C5 damage) opposite the girder flange. Removal of weld backing at these connections results in a significant cost increase that is probably not warranted unless UT indicates widespread, significant defects and/or damage in the building.

The proper scanning techniques, beam angle(s) and transducer sizes should be used as specified in the written UT procedure contained in the Written Practice, prepared in accordance with Section 5.3.3 of these Interim Guidelines. The acceptance standard should be that specified in the original contract documents, but in no case should it be less than the acceptance criteria of AWS D1.1, Chapter 8, for Statically Loaded Structures.

The base metal should be scanned with UT for cracks. Cracks which have propagated to the surface of the weld or beam and column base metal will probably have been detected by visual inspection and magnetic particle tests performed earlier. The purpose of ultrasonic testing of the base metal is to:

1. Locate and describe the extent of internal indications not apparent on the surface and,

2. Determine the extent of cracks found visually and by magnetic particle test.

Commentary: Liquid dye penetrant testing (PT) may be used where MT is precluded due to geometrical conditions or restricted access. Note that more stringent requirements for surface preparation are required for PT than MT, per AWS D1.1.

If practical, NDT should be performed across the full width of the bottom beam flange joint. However, if there are no discontinuity signals from UT of accessible faces on one side of the bottom flange weld, obstructions on the other side of the connection need not be removed for testing of the bottom flange weld.

Slabs, flooring and roofing need not be removed to permit NDT of the top flange joint unless there is significant visible damage at the bottom beam flange, adjacent column flange, column web, or shear connection. Unless such damage is present, NDT of the top flange should be performed as permitted, without local removal of the diaphragms or perimeter wall obstructions.

It should be noted that UT is not 100% effective in locating discontinuities and defects in CJP beam flange to column flange welds. The ability of UT to reliably detect such defects is very dependent on the skill of the operator and the care taken in the inspection. Even under perfect conditions, it is difficult to obtain reliable readings of conditions at the center of the beam flange to column flange connection as return signals are obscured by the presence of the beam web. If backing is left in place on the welds, UT becomes even less reliable. There have been a number of reported instances in which UT indicated apparent defects, that were found not to exist upon removal of the backing. Similarly, UT has failed in some cases to locate defects that were later discovered upon removal of the backing. Additional information on UT may be found in AWS B1.10.

5.3.3 Inspector Qualification

Testing shall be performed and supervised by qualified and properly certified technicians. It is recommended that the structural engineer (or his/her agent) observe the inspection procedures directly until such a time that confidence is developed that the inspections are being made in accordance with the given instructions. It is the responsibility of the structural engineer in charge to confirm that only certified Level II technicians, certified in accordance with AWS D1.1-1994 Section 6.1.3.1 and 6.7.8 and SNT-TC-1A, are allowed to execute VI and NDT, under the supervision of a Level III technician with current certification by examination. All Level II certifications should be current, having been issued within 3 years *prior* to the start of the inspection program. The structural engineer should require that the inspector provide a Written Practice for his/her review and approval, and the building owner's file, in accordance with the requirements of SNT-TC-1A. The Written Practice should as a minimum provide 1) all certification records for all technicians executing VI and NDT on the project and 2) the detailed

UT, MT and PT procedures used to perform NDT of WSMF connections, as well as other types of connections, in accordance with the instructions of the structural engineer.

Commentary: Special care is recommended in the selection of inspectors because VI and NDT methods are highly dependent on the skill and integrity of the operator for proper interpretation of the results.

5.3.4 Post-Earthquake Field Inspection Report

A Field Inspection Report for both VI and NDT should be completed for each connection inspected and/or tested, regardless of whether damage or rejectable defects are detected. There are two (2) CJP welds for each WSMF beam-to-column connection. A standard form should be used to ensure complete documentation. Sample Field Inspection Report forms are provided in Figure 5-2 through 5-5. The technician should record the depth, length and location of observed indications, should characterize the discontinuities as planar (cracks or lack of fusion) or volumetric (porosity, slag, etc.), should classify the weld as acceptable or rejectable according to predetermined criteria, and should note any uncertainties. In addition, the form should record the date of testing, the person responsible, connection location and orientation, and descriptions of items not tested due to limited access. The Field Inspection Report form should, as a minimum, objectively identify for each CJP weld and shear tab tested the following information, as applicable:

a) Damage/Defect type classification/description (per Section 3-1, and summarized for convenience at the rear of this Chapter as Table 5-1).
b) AWS Discontinuity Severity Class of crack/defect per Table 8.2 of AWS D1.1-94.
c) Depth of crack/defect.
d) Length of crack/defect/damaged material.
e) Location of crack/defect/damaged material.
f) Identification of NDT procedure used.
g) Possible inclusion of photographs.

Commentary: To ensure a correct understanding and identification of reported connection damage, the format of the Field Inspection Report form should include an easy to understand graphic description of what face of the connection is being inspected (e.g., north face, south face, east or west) and at what framing elevation the connection is located (e.g., inspector is standing on the 4th floor and looking at a connection located at the 5th floor framing). In addition, any identified significant damage should be recorded on a generic sketch of the WSMF standard joint detail to facilitate consistent reporting and correct interpretation and assessment by the structural engineer.

5.3.5 Written Report

Following completion of the detailed damage assessments, the structural engineer should prepare a written report, in accordance with Section 4.3.9.

Table 5-1 - Connection Damage Classification

Type	Location	Description
G1	Girder	Buckled Flange
G2	Girder	Yielded Flange
G3	Girder	Top or Bottom Flange fracture in HAZ
G4	Girder	Top or Bottom Flange fracture outside HAZ
G5	Girder	Top and Bottom Flange fracture
G6	Girder	Yielding or Buckling of Web
G7	Girder	Fracture of Web
G8	Girder	Lateral-torsional Buckling
C1	Column	Incipient flange crack (detectable by UT)
C2	Column	Flange tear-out or divot
C3	Column	Full or partial flange crack outside HAZ
C4	Column	Full or partial flange crack in HAZ
C5	Column	Lamellar flange tearing
C6	Column	Buckled Flange
C7	Column	Fractured column splice
W1a	CJP weld	Minor root indication, thickness < 3/16” or $t_f/4$; width $\leq b_f/4$
W1b	CJP weld	Root indication, thickness > 3/16” or $t_f/4$; width > $b_f/4$
W2	CJP weld	Crack through weld metal thickness
W3	CJP weld	Fracture at girder interface
W4	CJP weld	Fracture at column interface
W5	CJP weld	UT detectable indication—non-rejectable
S1a	Shear tab	Partial crack at weld to column (beam flanges sound)
S1b	Shear tab	Partial crack at weld to column (beam flange cracked)
S2a	Shear tab	Crack in Supplemental Weld (beam flanges sound)
S2b	Shear tab	Crack in Supplemental Weld (beam flange cracked)
S3	Shear tab	Fracture through tab at bolt holes
S4	Shear tab	Yielding or buckling of tab
S5	Shear tab	Damaged, or missing bolts
S6	Shear tab	Full length fracture of weld to column
P1	Panel Zone	Fracture, buckle, or yield of continuity plate
P2	Panel Zone	Fracture of continuity plate welds
P3	Panel Zone	Yielding or ductile deformation of web
P4	Panel Zone	Fracture of doubler plate welds
P5	Panel Zone	Partial depth fracture in doubler plate
P6	Panel Zone	Partial depth fracture in web
P7	Panel Zone	Full (or near full) depth fracture in web or doubler plate
P8	Panel Zone	Web buckling
P9	Panel Zone	Fully severed column

Figure 5-2 Inspection Form - Major Axis Column Connection

Figure 5-3 Inspection Form - Large Discontinuities - Major Axis

Figure 5-4 Inspection Form - Major Axis Column Connection

Figure 5-5 Inspection Form - Large Discontinuities - Minor Axis