SNBI Condition, Inspection and Element Data

Section 6 (Inspections) and Section 7 (Bridge Condition) of the FHWA Specifications for the National Bridge Inventory (SNBI) are where field inspection results become national data. This course walks through the SNBI component condition rating items, the new rating vocabulary of defect severity and extent, the inspection-event records that replace the old single inspection date, and the element data reported for NHS bridges, with worked examples drawn from the SNBI itself and the coding errors most likely to appear during the transition.

Learning objectives

- Describe how SNBI records component conditions
- Explain the role of element data in the SNBI
- Identify new inspection-event data
- Avoid common coding errors during transition

Where condition and inspection data live in the SNBI

The SNBI (FHWA-HIF-22-017, March 2022) is incorporated by reference in 23 CFR 650.317, and 23 CFR 650.315(a) requires that inventory data be collected and reported according to it. Two of its seven sections carry almost everything an inspector produces in the field.

Section 6, Inspections, has two subsections. Subsection 6.1, Inspection Requirements, holds four items that flag which special inspection types a bridge needs: B.IR.01 (NSTM Inspection Required), B.IR.02 (Fatigue Details), B.IR.03 (Underwater Inspection Required) and B.IR.04 (Complex Feature). Subsection 6.2, Inspection Events, holds twelve items, B.IE.01 through B.IE.12, reported once for every inspection event.

Section 7, Bridge Condition, has five subsections: 7.1 Component Condition Ratings (B.C.01 to B.C.15), 7.2 Element Identification (B.E.01 to B.E.03), 7.3 Element Conditions (B.CS.01 to B.CS.04), 7.4 Appraisal (B.AP.01 to B.AP.05) and 7.5 Work Events (B.W.01 to B.W.03).

The relationship of each subsection to the bridge record matters for data managers. Component condition ratings and appraisal items are part of the Primary Data Set and have a one-to-one relationship with the bridge: one current value per bridge, which may change after each inspection. Inspection events are many-to-one: each event is a separate record, and FHWA keeps the history of all events reported over the life of the bridge. Elements are also many-to-one: one record per element present on the bridge. Work events are reported as one record per year in which work was performed, with Year Built (B.W.01) kept in the Primary Data Set.

The practical consequence is that a single field visit can create several data records. A routine inspection that also includes an NSTM inspection produces two inspection-event records, updates the one-to-one component ratings, and, on an NHS bridge, updates the condition-state quantities for every element.

The component condition rating scale (Table 20)

The SNBI rewrote the familiar 0 to 9 scale. The codes and condition names are recognizable from the Coding Guide, but the descriptions are now written in terms of the **severity** and **extent** of defects and their effect on strength and performance. SNBI Table 20 applies to Items B.C.01 through B.C.07 (deck, superstructure, substructure, culvert, bridge railings, railing transitions and bearings):

- **N, Not applicable**: component does not exist.
- **9, Excellent**: isolated inherent defects.
- **8, Very good**: some inherent defects.
- **7, Good**: some minor defects.
- **6, Satisfactory**: widespread minor or isolated moderate defects.
- **5, Fair**: some moderate defects; strength and performance of the component are not affected.
- **4, Poor**: widespread moderate or isolated major defects; strength and/or performance of the component is affected.
- **3, Serious**: major defects; strength and/or performance is seriously affected. Condition typically necessitates more frequent monitoring, load restrictions and/or corrective actions.
- **2, Critical**: major defects; component is severely compromised. Condition typically necessitates frequent monitoring, significant load restrictions and/or corrective actions in order to keep the bridge open.
- **1, Imminent failure**: bridge is closed to traffic due to component condition. Repair or rehabilitation may return the bridge to service.
- **0, Failed**: bridge is closed due to component condition and is beyond corrective action. Replacement is required to restore service.

The SNBI states that the **entire code description must be satisfied** for a code to apply. That sentence does a lot of work. A deck with widespread moderate defects cannot be a 5, because a 5 describes only "some" moderate defects; it falls to at least a 4. And a component cannot be a 4 unless strength and/or performance is actually affected, which for a major defect is determined by a structural and/or hydraulic review.

Severity and extent: the defect vocabulary

Section 7.1 defines the words used in the rating tables, and consistent use of these words is the single biggest improvement the SNBI offers over the old narrative descriptions.

Severity

- An **inherent defect** is not indicative of damage or deterioration; it is characteristic of the material or results from normal construction practices. Fine shrinkage cracking in a concrete deck is the classic example.
- A **minor defect** is one where damage or deterioration has initiated but is not yet considered significant.
- A **moderate defect** is one where damage or deterioration is significant, but the strength and performance of the component are not affected.
- A **major defect** affects the strength and/or performance of the component, as determined by a structural and/or hydraulic review. For joints, bearings, railings and railing transitions, a major defect prevents the component from functioning as intended.

Extent

- **Isolated**: the defect occurs in one or a few concentrated locations.

- **Widespread**: the defect is present in many separate areas of the component.
- **Some**: prevalence is more than isolated and less than widespread.

The term "defect" in these tables means a problem with the component that may be caused by deterioration, damage or an inherent defect. Two clarifications in the SNBI are worth memorizing. First, load posting alone, for an existing bridge designed for less than current legal loads, is not a defect and does not affect the condition rating. Second, portions of components supported or strengthened by temporary members are evaluated considering the condition of the temporary members as well. Optional tables in SNBI Appendix C give additional guidance on specific defects and deterioration mechanisms.

Inspection events in brief

Under the Coding Guide, the NBI held a single most-recent inspection date and a few frequency fields. The SNBI instead records each inspection as an event. Item B.IE.01 (Inspection Type) uses nine codes: 1 Initial, 2 Routine, 3 Underwater, 4 NSTM, 5 Damage, 6 In-Depth, 7 Special, 8 Service and 9 Scour Monitoring. Each event then carries begin and completion dates, the Nationally Certified Bridge Inspector (team leader) code, the planned interval, the risk-based interval method, QC and QA review dates, the date data were entered into the agency inventory, a note when only part of the bridge was inspected, and the access and testing equipment used. These are covered item by item later in the course.

Part A — Rating the deck (B.C.01)

Item B.C.01 represents the condition of the deck as determined from inspection of **all deck surfaces**: top, underside and edges. It is reported as N when Item B.SP.09 (Deck Material and Type) is 0, meaning there is no deck. The SNBI commentary adds several rules that change long-standing habits in some agencies.

- **Hidden surfaces.** When the top, the underside or both are not visible, use destructive or non-destructive testing results, or visual indicators from the materials covering the surface. Past inspection reports and repair records may also inform the rating. A deck under an asphalt overlay on stay-in-place forms is not automatically "unknown"; reflective cracking, potholes that expose delaminated concrete, efflorescence or rust staining at form seams, and prior chain-drag or GPR data all count as evidence.
- **What not to rate.** Do not consider non-monolithic wearing surfaces (overlays), stay-in-place deck forms, joint assemblies, expansion devices, bridge rails or scuppers, except insofar as they indicate the condition of the deck itself. A cracked asphalt overlay is not a deck defect; a pothole through the overlay that reveals spalled deck concrete is.
- **Joint headers.** Consider the condition of a joint header only when the deck itself serves as the header.
- **Integral top flanges.** For decked girders, tee beams, voided slab beams, box girders and rigid frames, the deck condition may affect the superstructure rating, but the superstructure condition does not affect the deck rating.
- **Slabs.** The deck and superstructure condition ratings are the same for slab bridges.

Worked example from the SNBI

The SNBI illustrates the deck item with a reinforced concrete deck roughly 270 ft long by 40 ft wide. Inspectors found full-width transverse cracks about 0.010 in. wide at 3 to 5 ft spacing for the full length (classified as inherent and widespread); about 40 ft² of spalls more than 1 in. deep along an expansion joint; and two groups of spalls up to 24 in. by 18 in., more than 1 in. deep, with exposed reinforcing but no section loss, together with unsound patches, totaling about 100 ft² and 130 ft². Each spall group was classified as moderate and isolated.

The reasoning in the SNBI is instructive. Several areas of isolated moderate defects, taken together, are best characterized as "some moderate defects." The rest of the deck had only inherent defects, nothing was visible on the underside, and nothing indicated a more significant problem. "Some moderate defects; strength and performance not affected" is the definition of code 5. Notice what the inspector did not do: rate the deck down for the widespread cracking (it was inherent), or treat exposed bar without section loss as a major defect.

Practical cautions

Do not let a single dramatic photo drive the rating. The rating describes the deck as a whole, so the inspector should be able to state, in words, the severity and extent of the governing defects. A useful habit is to write the rating justification in the same structure the SNBI uses: list each defect with its location, severity and extent, then state which Table 20 description is fully satisfied. That narrative is also exactly what a QC reviewer needs to confirm the code.

Part A — Rating the superstructure (B.C.02)

Item B.C.02 represents the condition of the superstructure from inspection of all superstructure members. It is reported as N when M (main span), A (approach span) or W (widening) is not reported for Item B.SP.01, Span Configuration Designation; in practice, that means culverts are rated under B.C.04 instead.

The commentary defines what counts as superstructure:

- members above the bearings for bridges with non-integral superstructure;
- girders and beams for integral superstructures;
- members above the spring line for arch bridges;
- slabs of concrete rigid frame bridges; and
- legs, knees and girders for concrete and steel rigid K-frame or delta-frame bridges.

Consider primary load-carrying members, which for curved girder bridges includes cross-frames and diaphragms. Consider secondary members only if they adversely affect the primary members. Consider integral headwalls and wingwalls to the first expansion joint.

Several exclusions mirror the deck item. Do not consider bearings except where they are causing distress in the superstructure. Do not consider protective coatings except where coating problems indicate problems in the underlying material; the SNBI specifically states that a well-formed patina on weathering steel is considered a protective coating and is not a defect. Do not consider drift, debris or soil accumulation except where it is causing distress.

Superstructure types without substructures, such as some arches and frames on footings, may be affected by scour. When observed conditions are not consistent with the scour design or the assumptions in the scour appraisal, scour is considered in this item and Item B.AP.03 (Scour Vulnerability) should be reevaluated. Observed scour less than the tolerable limit from the scour appraisal does not affect the rating.

Worked example from the SNBI

A two-span steel truss, each span 200 ft by 34 ft, had four defect groups: distortion of one vertical (moderate, isolated, after structural review found it did not affect strength); corrosion with less than 10% section loss at 20 of 28 floor beam ends (moderate, "some"); freckled rust throughout the trusses, floor beams and stringers (minor, widespread); and broken or

missing rivets at 8 stringer-to-floor-beam connections, which a structural review determined affected strength but did not necessitate load restrictions (major, isolated).

The governing finding is the isolated major defect. Because strength is affected but the condition does not require more frequent monitoring, corrective actions or load restrictions, the superstructure is coded **4**, not 3. The example shows the two decision points that separate 4, 3 and 2: whether strength is affected at all, and then what operational response the condition typically requires.

Part A — Substructure (B.C.03) and culverts (B.C.04)

Substructure. B.C.03 addresses piers, abutments, piles, footings and other substructure members. It is reported as N when only C and/or V (culvert configurations) are reported for B.SP.01. The substructure includes backwalls and members below the bearings for non-integral bridges; members below the girders for integral superstructures; thrust blocks and members below the spring line for arches; legs of concrete rigid frames; abutments and footings below the leg bearings for K-frame and delta-frame bridges; and foundation piles exposed by erosion or scour. Integral abutment wingwalls are considered to the first construction or expansion joint.

When substructure elements are not visible, the inspector uses indicators from the superstructure or the surrounding foundation materials: misaligned bearings, tilted or rotated walls, settlement visible at the deck joints, or approach slab drops. Protective coatings, fenders and other protection systems are not considered except where they indicate or cause substructure distress. As with the superstructure, scour is considered in this item only when observed conditions are inconsistent with the scour design or appraisal assumptions, and that inconsistency also triggers reevaluation of B.AP.03.

The SNBI example is a four-span prestressed concrete bridge with RC abutments and piers. Defects were a 12 ft long, 2 in. deep spall with exposed, rusting reinforcement on one cap; rust-stained cracking over 6 ft of another cap; and an 11 ft crack in one column that a structural review found did not affect strength or performance. All were moderate and isolated; together they constitute "some moderate defects" without effect on strength or performance, so the substructure is coded **5**.

Culverts. B.C.04 addresses culverts, including footings, piles and other foundation members when present, and is reported as N when C or V is not reported for B.SP.01. Integral wingwalls and headwalls are considered to the first construction or expansion joint, and footings below the walls of a three-sided box are included. The rules on non-visible components, coatings, debris and scour parallel the substructure item.

The SNBI culvert example is a three-barrel corrugated metal pipe culvert, each barrel 8 ft in diameter and 100 ft long. Corrosion with section loss over about 20% of the total barrel length was major with "some" extent; intolerable settlement and distortion at one location was major and isolated; and general corrosion throughout was minor and widespread. The combination of major defects seriously affecting the culvert led to a code of 3. The lesson for culvert inspectors is that the extent of section loss along the barrel, not just its depth at one spot, drives the rating.

One rating per component, not per span

Even though the SNBI allows multiple span and substructure configuration records, B.C.01 through B.C.04 remain one-to-one with the bridge. A long bridge with a deteriorated approach and a sound main span gets a single superstructure rating reflecting the overall component per Table 20. Element data, discussed later, is where quantity-by-condition detail is captured.

Part B — New component items: railings, transitions, bearings and joints

One of the most visible SNBI changes is that railings, railing transitions, bearings and joints now receive their own 0 to 9 condition ratings. Under the Coding Guide, these were either folded into the deck and superstructure ratings or captured only through appraisal codes. Because these components can be replaced without touching the primary structure, rating them separately gives owners a much better picture of maintenance needs.

Bridge railings, B.C.05

B.C.05 covers all types and shapes of bridge railings, including parapets, median barriers and structure-mounted rails, and includes the posts, blocking and curbs that are part of the railing system. Report N when no bridge railing is present. Pedestrian railings are not considered except where they are integral to the traffic barrier. Coatings are considered only where coating problems indicate problems in the underlying rail. Table 20 applies, and for railings a **major defect is one that prevents the component from functioning as intended**.

The SNBI example is a 300 ft bridge with steel W-beam rail on both sides. Impact damage had distorted 25 ft of rail and three posts were no longer connected to the deck. That is isolated in extent, but the rail could no longer function as intended over that length, so it is a major defect and the railing is coded **4**.

Bridge railing transitions, B.C.06

B.C.06 covers the transition from the bridge railing to the approach guardrail, including the rails, posts, blocking and curbs that are part of the transition. Report N when there are no transitions. Because transitions are frequent sites of vehicle impact and of nonstandard retrofits, inspectors should note missing blocks, loose or missing bolts at the connection to the bridge rail end, and posts undermined by erosion at the bridge ends.

Bridge bearings, B.C.07

B.C.07 covers all types and shapes of bearings and is reported as N for bridges without bearings. When the bearing device is not visible, condition may be assessed from alignment, grade across the joint, or other indirect indicators. The SNBI gives three instructive examples:

- 5 of 25 bearings with 10% loss of bearing area: "some" extent (20% of bearings), moderate severity; code **5**.
- 8 of 20 bearings rotated beyond performance limits, with bent anchor bolts and loose nuts, and surface rust on all bearings: major defects affecting performance that necessitate more frequent monitoring or corrective action; code **3**.
- All 20 bearings with surface rust but no section loss, free to move and aligned as expected for the temperature: widespread minor defects; code **6**.

Bridge joints, B.C.08

Joints use their own table rather than Table 20. Code 9 to 6 match the general pattern (isolated inherent; some inherent; some minor; widespread minor or isolated moderate). Below that the descriptions are simpler: 5, some moderate defects; 4, widespread moderate or isolated major defects; 3, some major defects; 2, widespread major defects; 1, joints have failed and are ineffective; 0, joints have failed and present a safety hazard. N means the bridge has no deck joints.

The assessment includes seals, headers (metal or concrete), connections and other metal members. When a joint is designed as an open joint, leakage or lack of a seal is **not** a defect. The SNBI examples show the reasoning: compression seals partly filled with debris but still free to move, at all joints, is widespread minor, code 6; a 3 in. deep spall with exposed bar beside a strip-

seal header over 6 ft of one joint, with the seal intact and functioning, is isolated moderate, also code 6; compression seals torn and partly pulled out for the full length of both joints, affecting performance, is widespread moderate, code 4.

Part B — Waterway items: channel, channel protection and scour

Three items rate the waterway rather than the structure. All are reported as N when the bridge does not cross water.

Channel condition, B.C.09

B.C.09 rates the channel at the bridge, considering upstream and downstream reaches only insofar as they threaten the bridge and approach roadway. Its scale tops out at **8** (very good, inherent defects only) rather than 9. The middle codes refer to whether the bridge and approach roadway are threatened: 5 (fair) moderate defects with the bridge and approach not threatened; 4 (poor) widespread moderate or isolated major defects with the bridge and/or approach threatened; 3 and 2 major defects with the bridge seriously or severely threatened. Codes 1 and 0 mean the bridge is closed due to channel condition, with 0 meaning the bridge location or design can no longer accommodate the channel. For concrete-lined channels, channel defects typically do not apply except aggradation and debris; the lining itself is rated under B.C.10.

Channel protection condition, B.C.10

B.C.10 rates the condition and effectiveness of channel protection devices installed on banks or in the stream to mitigate channel issues that may affect the bridge. Report N when the bridge does not cross water or channel protection is not present. The SNBI treats these devices as countermeasures, both river-training measures (spurs, bendway weirs, guide banks, drop structures, check dams) and armoring (rock riprap, grouted riprap, concrete slope paving, articulating concrete blocks, gabion mattresses, grout-filled mats), and refers to FHWA HEC-23 for others. The inspector considers erosion and scour, damage such as unraveling, displacement, separation and sagging, and material defects such as scaling, abrasion, spalling, corrosion, cracking, splitting and decay.

For this item a minor defect does not limit the effectiveness of the protection, a moderate defect may limit it, and a major defect means the protection is missing or no longer effective as determined by a hydraulic review. In the SNBI example, stones were missing, the revetment had limited effectiveness, and the streambed was scouring and undermining the remaining riprap and the culvert: widespread moderate defects affecting performance, code **4**.

Scour condition, B.C.11

B.C.11 is new and important. It rates the *observed or measured* scour, as opposed to B.AP.03 (Scour Vulnerability), which is the appraisal of whether the bridge is stable for assessed scour conditions. The codes run from 9 (no scour) down to 0; for example, 6 is widespread minor or isolated moderate scour; 5 is moderate scour with strength and stability not affected; 4 is widespread moderate or isolated major scour with strength and/or stability affected; 3 and 2 are major scour that seriously affects or severely compromises the bridge; 1 and 0 mean the bridge is closed due to scour condition.

The commentary directs inspectors to consider design scour depth and critical scour depth from the hydraulic design, scour evaluation and Plan of Action (POA). Observed conditions inconsistent with the scour design or appraisal assumptions indicate a need to reevaluate B.AP.03. The SNBI examples are worth studying:

- A scour-critical bridge on spread footings not on rock, where three footings at one pier are scoured to the bottom of footing and one is undermined about 1 ft at a corner, and the agency plans more frequent monitoring to keep the bridge open: major scour, code **3**.

- A scour-critical bridge with a critical scour limit in the POA, and minor scour at one of five bents that does not exceed the tolerable limit: isolated minor scour, code **7**.
- A bridge appraised as not scour critical, with no scour calculations or stability analysis and piles end-bearing on rock, where measured cross-sections show scour at piers not consistent with the appraisal assumptions: isolated major scour warranting a structural and/or hydraulic review, code **4**. Because the observations are inconsistent with the appraisal, scour is also considered in B.C.03 and B.AP.03 is reevaluated.

The last example shows why cross-section measurements at every inspection matter: without them, an inspector cannot tell whether scour is consistent with what the appraisal assumed.

Part C — Calculated items and the special-inspection conditions (B.C.12 to B.C.15)

Items B.C.12 and B.C.13 are calculated by FHWA from other SNBI items and are not reported by the agency. The SNBI writes them in passive voice to signal that they are presented for reference only.

B.C.12, Bridge Condition Classification, supports the national performance measures (23 CFR 490 Subpart D). It is the minimum (lowest) of B.C.01 (deck), B.C.02 (superstructure), B.C.03 (substructure) and B.C.04 (culvert), classified as **G (Good)** for 7, 8 or 9; **F (Fair)** for 5 or 6; and **P (Poor)** for 4 or below. The SNBI examples: an RC closed-spandrel arch with superstructure 7 and substructure 8 is Good; a corrugated metal pipe culvert rated 5 is Fair; a steel box girder bridge with deck 4, superstructure 6 and substructure 7 is Poor.

B.C.13, Lowest Condition Rating Code, is simply that lowest value: 7, 5 and 4 respectively in the same examples.

Notice what is *not* in the calculation. The new railing, transition, bearing, joint, channel, channel protection and scour ratings do not change the Good/Fair/Poor classification. A bridge with failed joints and a railing rated 3 can still be "Good" for performance-measure purposes if its deck, superstructure and substructure are 7 or better. Owners who want those components to drive programming must do so through their own asset management policy.

NSTM Inspection Condition, B.C.14

B.C.14 reports the condition of the nonredundant steel tension members (NSTMs) identified for inspection in the NSTM inspection procedures, using Table 20. It is not reported when B.IR.01 (NSTM Inspection Required) is N. If a bridge has NSTMs in both the superstructure and the substructure, report only the lower of the two. The NSTM condition is also incorporated into the superstructure or substructure rating; B.C.14 does not replace them, it isolates the members that drive NSTM inspection intervals.

Underwater Inspection Condition, B.C.15

B.C.15 reports the condition of the underwater members of the substructure based on the underwater inspection, again using Table 20, and is incorporated into the substructure rating. It is not reported when B.IR.03 (Underwater Inspection Required) is N. If it has been reported because an underwater inspection is generally required, it should continue to be reported even in an unusually low-flow year when everything could be waded and probed, provided the low flow is truly unusual.

The inspection-requirement flags, B.IR.01 to B.IR.04

- **B.IR.01 NSTM Inspection Required**: N (not required), Y (required), I (not required — internal redundancy demonstrated to FHWA through nationally recognized methods) or S (not required — system redundancy demonstrated

to FHWA). Not reported for bridges without steel members. A State may record Y for bridges meeting a State definition more rigorous than FHWA's.
- **B.IR.02 Fatigue Details**: Y when AASHTO fatigue category E or E′ details are present, N otherwise. Not reported for bridges without steel members.
- **B.IR.03 Underwater Inspection Required**: Y when, during a typical routine inspection, any portion of the substructure and surrounding channel cannot be inspected to the mudline at low water by wading or probing. Not reported for bridges that do not pass over water.
- **B.IR.04 Complex Feature**: Y when the bridge has a complex feature as defined in the NBIS, typically identified in agency policy.

These flags matter because they control which conditional items and inspection-event types are expected. A Y in B.IR.01 with no NSTM inspection events, or an NSTM event on a bridge flagged N, is an obvious validation failure.

Part C — Inspection events item by item (B.IE.01 to B.IE.06)

If more than one type of inspection is performed on a date, a **separate inspection data set is reported for each type**. Inspection events already accepted into the NBI in prior years need not be re-reported unless they were incomplete or incorrect; to correct one, report a complete new event data set that includes the originally submitted inspection type and begin date.

B.IE.01 Inspection Type

Codes: 1 Initial, 2 Routine, 3 Underwater, 4 NSTM, 5 Damage, 6 In-Depth, 7 Special, 8 Service, 9 Scour Monitoring. The commentary gives the boundaries:

- Use **2** when all of the substructure and surrounding channel were inspected to the mudline at low water visually or by wading or probing during a routine inspection.
- Use **3** when a bridge flagged Y for B.IR.03 is inspected by wading and probing in unusually low flow; if done during a routine inspection, record both a routine and an underwater event.
- Use **8** for a Service inspection performed on a bridge whose risk-based routine interval exceeds 48 months.
- Use **9** for scour monitoring required by a scour POA for a triggering storm event, including periodic remote electronic readings if the POA requires them. Multiple site visits for one storm are recorded once.

SNBI examples: the initial inspection of a widened bridge is 1; a twelve-month inspection of an entire poor-condition bridge is 2; an unscheduled inspection after a vehicle impact is 5; a hands-on NDT inspection of pins is 6; an NDT assessment of stay cables (a complex feature) is 6; an inspection of only the girders of a load-restricted bridge is 7.

B.IE.02 and B.IE.03, Begin and Completion Dates

Both are YYYYMMDD. The begin date is the first day the field inspection begins; the completion date is the last day of field work, and is the same as the begin date for single-day inspections. For scour monitoring with multiple site visits during one storm, report the first visit as the begin date and the last visit as the completion date. In the SNBI example, a routine and an NSTM inspection both began August 1, 2020; the routine finished August 2 and the NSTM August 4, so the events carry different completion dates.

B.IE.04 Nationally Certified Bridge Inspector

A code of up to 15 characters, assigned by the State DOT, Federal agency or Tribal government, identifying the team leader responsible for that inspection type. Agencies may choose not to report it for inspection types that the NBIS does not require a team leader for, even if one was present. In the SNBI example, a contractor representative performing an operational check of a cathodic protection system was not a certified inspector, so B.IE.04 was left blank for that Special inspection.

B.IE.05 Inspection Interval and B.IE.06 Due Date

B.IE.05 is the planned interval in months to the next inspection of the same type, and it should be evaluated after each inspection and adjusted as needed. Report **0** for damage inspections, scour monitoring, and special inspections without a defined interval. In the SNBI example, a routine inspection that had been on an approved 48-month interval was reduced to 24 months after worsening deterioration was found, so 24 is reported. B.IE.06 is **calculated by FHWA** as the completion date plus the interval and is not reported by the agency.

Part C — Inspection events item by item (B.IE.07 to B.IE.12)

B.IE.07 Risk-Based Inspection Interval Method

Codes N (not applicable), 1 (Method 1) and 2 (Method 2). Method 1 is the NBIS simplified assessment that places each bridge in one of three risk levels with intervals not to exceed 12, 24 or 48 months. Method 2 is the more rigorous assessment that places a bridge or group of bridges in one of four risk levels with intervals not to exceed 12, 24, 48 or 72 months. Use N when B.IE.01 is 1, 5, 6, 7, 8 or 9, so the method is reported only for routine, underwater and NSTM events.

B.IE.08 QC Date and B.IE.09 QA Date

B.IE.08 is the date an independent quality control review of that inspection was completed; B.IE.09 is the date a quality assurance review was completed. Neither is reported if the review was not done. The commentary acknowledges that not every inspection receives an independent QC review and that QA samples may be random or targeted by bridge type, region or district. In the SNBI example, routine and NSTM inspections received a QC review on September 15, 2020, and the routine inspection alone was randomly selected for a QA review on January 4, 2021.

B.IE.10 Inspection Data Update Date

The date NBI inspection data were entered or updated in the agency inventory. Its purpose is to verify compliance with 23 CFR 650.315(b), which requires changes to inventory data for all inspection types to be entered **within 3 months after the month when the field portion of the inspection is completed**. Related deadlines in 650.315(c) and (d) apply the same 3-month window after the month of opening to traffic for new or modified bridges, and after the month a change in load restriction or closure status is implemented.

B.IE.11 Inspection Note

Up to 300 characters describing the members or features inspected when only limited portions of the bridge are inspected, as in underwater, NSTM, in-depth, special and damage inspections and scour monitoring, and the purpose of special inspections after floods, hurricanes or earthquakes. Use consistent terms for similar inspections. If all portions of the bridge were inspected, the note is not needed. SNBI examples include "Hands-on inspection of all girders and floor beams in spans 2 and 3" and, for scour monitoring during a flood, "Bridge was visually monitored for damage and alignment issues during flooding."

B.IE.12 Inspection Equipment

Up to 120 characters of pipe-delimited codes for access and inspection equipment used beyond standard equipment. Access codes run AN (none) and A01 through A14 plus AX (other); examples are A01 ladder, A02 bucket lift vehicle, A03 under-bridge inspection vehicle, A06 boat, A08 SCUBA, A09 surface-supplied air, A10 remotely operated vehicle, A11 video pole, A13 unmanned aerial systems and A14 service traveler. Inspection codes run IN (none) and I01 through I15 plus IX; examples are I01 ultrasonic, I02 ground-penetrating radar, I03 infrared thermography, I09 dye penetrant, I10 magnetic particle, I11 eddy current, I13 underwater imaging and I14 depth finder/fathometer.

SNBI examples: an NSTM inspection using an under-bridge inspection vehicle and magnetic particle testing is `A03|I10`; a dive inspection from a boat with surface-supplied air, preceded by side-scan sonar, is `A06|A09|I13`; a damage inspection from a bucket truck with dye penetrant and eddy current is `A02|I09|I11`. Pipe delimiters have no spaces.

Putting an event together

The SNBI's worked example for Bridge 15558X shows two events in one cycle. A routine inspection from March 17 to 18, 2016, team leader 29KFF007, 24-month interval under Method 1, QC March 25, 2016, QA March 17, 2017, equipment ladder, video pole and infrared thermography, no note needed because all portions were inspected. Then a special inspection on April 1, 2016 of the active cathodic protection system by a non-certified representative, 12-month interval, method N, QC April 8, no QA, equipment ladder and "other," with a note describing the system inspected and its status. FHWA calculates the due dates as March 18, 2018 and April 1, 2017.

Part D — Element identification (B.E.01 to B.E.03)

23 CFR 650.315(a) requires inventory data to include element-level inspection data for bridges on the National Highway System, collected according to the AASHTO Manual for Bridge Element Inspection (MBEI). The SNBI implements that requirement in Subsections 7.2 and 7.3. Element data are required only for bridges carrying NHS routes and are optional for other bridges; the NHS status comes from B.F.01 (Feature Type), B.F.02 (Feature Location) and B.H.03 (NHS Designation).

Three items identify each element:

- **B.E.01 Element Number**: the element number (EN) for each element on the bridge, chosen from SNBI Table 22, the list of elements reported to FHWA.
- **B.E.02 Element Parent Number**: for protective systems (wearing surfaces and protective coatings), the element number of the element being protected. Not reported for elements without a protective system role.
- **B.E.03 Element Total Quantity**: the total quantity, to the nearest whole unit, calculated per the MBEI (square feet for decks, slabs, wearing surfaces and coatings; linear feet for girders, stringers, rails, abutments, pier walls, caps and joints; each for columns, piles and bearings).

Table 22 organizes elements by material across columns for steel, prestressed concrete, reinforced concrete, timber, masonry and other. Some commonly used numbers: 12 (RC deck), 38 (RC slab), 107 (steel girder/beam), 109 (prestressed girder/beam), 110 (RC girder/beam), 205 (RC column), 210 (RC pier wall), 215 (RC abutment), 234 (RC pier cap), 300 (strip seal expansion joint), 310 (elastomeric bearing), 311 (movable bearing), 312 (enclosed/concealed bearing), 314 (pot bearing), 331 (RC bridge railing), 510 (wearing surface), 515 (steel protective coating) and 521 (concrete protective coating).

The SNBI makes two quieter but important points. First, element data must **correlate with the Bridge Material and Type section**: a bridge coded with steel girder spans in B.SP should not have only prestressed girder elements. Second, elements

entirely below ground and not accessible, such as buried piles, pile caps and footings, are not intended to be reported until they become exposed, although best-available data may be reported for elements that are hidden or were exposed and later covered.

Worked example from the SNBI

The SNBI example bridge has an RC deck of 14,462 ft² (EN 12) protected by 12,550 ft² of penetrating sealer (EN 521, parent 12); a cast-in-place RC voided slab of 15,340 ft² (EN 38) with 13,312 ft² of microsilica concrete overlay (EN 510, parent 38) which is itself sealed with 13,312 ft² of penetrating sealer (EN 521, parent 510); 1,755 ft of W36x135 steel beams (EN 107) with 15,287 ft² of coating (EN 515, parent 107); 806 ft of RC railing (EN 331); a 78 ft strip seal joint (EN 300); and several bearing types. Bearings cast into a semi-integral abutment are coded as enclosed/concealed (EN 312). No piles, caps or footings were exposed, so none were reported.

The protective-system chain is the detail most often coded wrong. A sealer applied over an overlay has the overlay (510) as its parent, not the deck, and the overlay has the deck or slab as its parent.

Part D — Element condition states (B.CS.01 to B.CS.04)

Every element has four condition states defined in the MBEI. The general intent, as the SNBI summarizes it, is **CS1 Good, CS2 Fair, CS3 Poor and CS4 Severe**. For each element, B.CS.01 through B.CS.04 report the quantity in each state to the nearest whole unit. The defining rule is arithmetic:

B.CS.01 + B.CS.02 + B.CS.03 + B.CS.04 = B.E.03 (Element Total Quantity).

The MBEI records element quantities by defect within each condition state, and agencies may keep that detail in their own systems, but the SNBI states that the defect-level quantities shown in the MBEI are not reported to FHWA. Only the four condition-state totals per element go into the NBI.

In the SNBI example table, an RC deck of 16,217 ft² has 0 ft² in CS1 and 16,000 ft² in CS2, with the remainder in poorer states; 2,054 ft of steel girder has 1,044 ft in CS1 and 1,000 ft in CS2; and 40 elastomeric bearings have 30 in CS1. The quantities illustrate that element data and component ratings tell different stories. The component rating describes the governing condition with a single number; the element quantities describe how much of the bridge is in each state, which is what deterioration models and preservation programs need.

How element data and component ratings should relate

The SNBI does not mechanically convert element quantities to component ratings, but the two must be consistent. A superstructure rated 7 (some minor defects) with half its girder length in CS3 is suspect; so is a deck rated 4 whose element record shows everything in CS1 and CS2. Many agencies run automated reasonableness checks between the two and flag outliers for QC review. Inspectors should expect to explain discrepancies, which do occur legitimately: a single isolated major defect can drive a component rating to 4 while affecting only a few linear feet of the element.

Units and rounding

Report whole units. Linear-foot elements such as girders are measured along each girder line, so a three-span bridge with nine beam lines has a girder quantity of roughly nine times the bridge length, not the bridge length. Deck and coating areas are surface areas per the MBEI. Bearings, columns and piles are counted each.

Part D — Common coding errors during the transition

FHWA's transition plan accepts transitioned (converted) data only for the early SNBI submittals; by the 2028 submittal every bridge must have collected and verified SNBI data. That means every inspector will touch Sections 6 and 7 on nearly every bridge in the next inspection cycle. The following errors follow directly from the SNBI rules covered in this course.

1. **Carrying a converted rating forward without reapplying Table 20.** A Coding Guide rating converted by a crosswalk is a starting point. The SNBI definitions are phrased differently, so the rating should be re-justified in severity-and-extent terms during the first SNBI inspection.
2. **Rating a major defect without a review.** Under the SNBI, a major defect is one that affects strength and/or performance as determined by a structural and/or hydraulic review. Coding 4 or below for a structural item should be backed by that review or by an evident performance loss.
3. **Lowering ratings for posting alone.** Posting an old bridge designed for lighter loads is not a defect.
4. **Rating coatings and overlays as structure.** Weathering steel patina, paint failure without section loss, and overlay cracking are not superstructure or deck defects, except insofar as they indicate problems below.
5. **Forgetting the new N rules.** B.C.04 is N on a bridge with no culvert configuration; B.C.02 and B.C.03 are N on a culvert-only record; B.C.08 is N with no joints; B.C.09 to B.C.11 are N over no water; B.C.14 is not reported when B.IR.01 is N; B.C.15 is not reported when B.IR.03 is N.
6. **Treating open joints as leaking defects.** For a joint designed open, leakage or lack of seal is not a defect.
7. **Confusing scour condition with scour vulnerability.** B.C.11 rates what was observed or measured; B.AP.03 is the appraisal. Inconsistency between the two triggers reevaluation of B.AP.03.
8. **Combining inspection types in one event.** A routine and an NSTM inspection on the same day are two events with their own completion dates, intervals and team leaders.
9. **Wrong interval values.** Damage, scour monitoring, and special inspections without a defined interval report 0 for B.IE.05, and B.IE.07 is N for initial, damage, in-depth, special, service and scour monitoring events.
10. **Reporting calculated items.** B.IE.06, B.C.12 and B.C.13 are calculated by FHWA.
11. **Spaces in pipe-delimited lists.** B.IE.12 uses codes separated by the pipe character with no spaces.
12. **Element quantities that do not sum.** Condition-state quantities must add to the total quantity, and protective-system elements need a correct parent number.
13. **Missing the 3-month entry window.** B.IE.10 makes compliance with 650.315(b) auditable for every event.

Part D — A field-to-database QC checklist

The following checklist can be used by a team leader before submitting a report, or by a QC reviewer before signing B.IE.08. Each line ties to an SNBI rule discussed above.

- Each component rating (B.C.01 to B.C.11) has a written justification listing the governing defects, their severity (inherent, minor, moderate, major) and extent (isolated, some, widespread), and the Table 20 or item-table description that is fully satisfied.
- Any rating of 4 or lower cites the structural or hydraulic review, or the observed loss of function for joints, bearings, railings and transitions.
- The deck rating considered all surfaces, used NDT or indicators where surfaces were hidden, and excluded overlays and stay-in-place forms except as indicators.
- Slab bridges have equal deck and superstructure ratings.

- Scour condition is consistent with measured cross-sections and the POA critical elevations; any inconsistency with the scour appraisal is flagged for B.AP.03 review and considered in the substructure or culvert rating.
- B.IR flags are consistent with the events reported (NSTM events only where B.IR.01 is Y; underwater events where B.IR.03 is Y or in an unusual low-water wading inspection).
- One inspection-event record exists for each inspection type performed, with begin and completion dates, team leader code, interval, method, and equipment codes.
- Inspection notes are present for any partial inspection and use the agency's standard phrasing.
- For NHS bridges, every element in Table 22 that is present and visible is reported, elements correlate with the span and substructure material and type, protective systems have parent numbers, and condition-state quantities sum to the total.
- Data entry is scheduled within 3 months after the month the field work was completed, and the date is captured in B.IE.10.

Finally, remember the division of labor among the documents. The NBIS (23 CFR 650 Subpart C) sets what inspections are required, by whom and how often. The MBEI defines elements, defects and condition states. The SNBI defines how all of this is coded and reported. Accurate national data requires using all three, and the current editions adopted by your agency, before sealing or submitting work.

Key takeaways

- SNBI condition ratings are defined by defect **severity** (inherent, minor, moderate, major) and **extent** (isolated, some, widespread), and the entire code description must be satisfied.
- A major defect requires a structural and/or hydraulic review finding that strength or performance is affected; for joints, bearings, railings and transitions it means the component no longer functions as intended.
- B.C.01–B.C.11 are reported by the agency; B.C.12 (Good/Fair/Poor) and B.C.13 (lowest rating) are calculated by FHWA from deck, superstructure, substructure and culvert.
- Every inspection is now an event record (B.IE.01–B.IE.12) with its own type, dates, team leader, interval, QC/QA dates and equipment.
- Element data are required for NHS bridges, and B.CS.01–B.CS.04 must sum to B.E.03.
- Inventory changes must be entered within 3 months after the month the field inspection is completed (23 CFR 650.315(b)).

References

1. FHWA, Specifications for the National Bridge Inventory (SNBI), FHWA-HIF-22-017, March 2022
2. 23 CFR Part 650, Subpart C — National Bridge Inspection Standards (final rule published May 6, 2022)
3. AASHTO, Manual for Bridge Element Inspection, 2nd Edition, 2019

Study text only; the final quiz is taken online. Verify all references against the edition your agency has adopted.