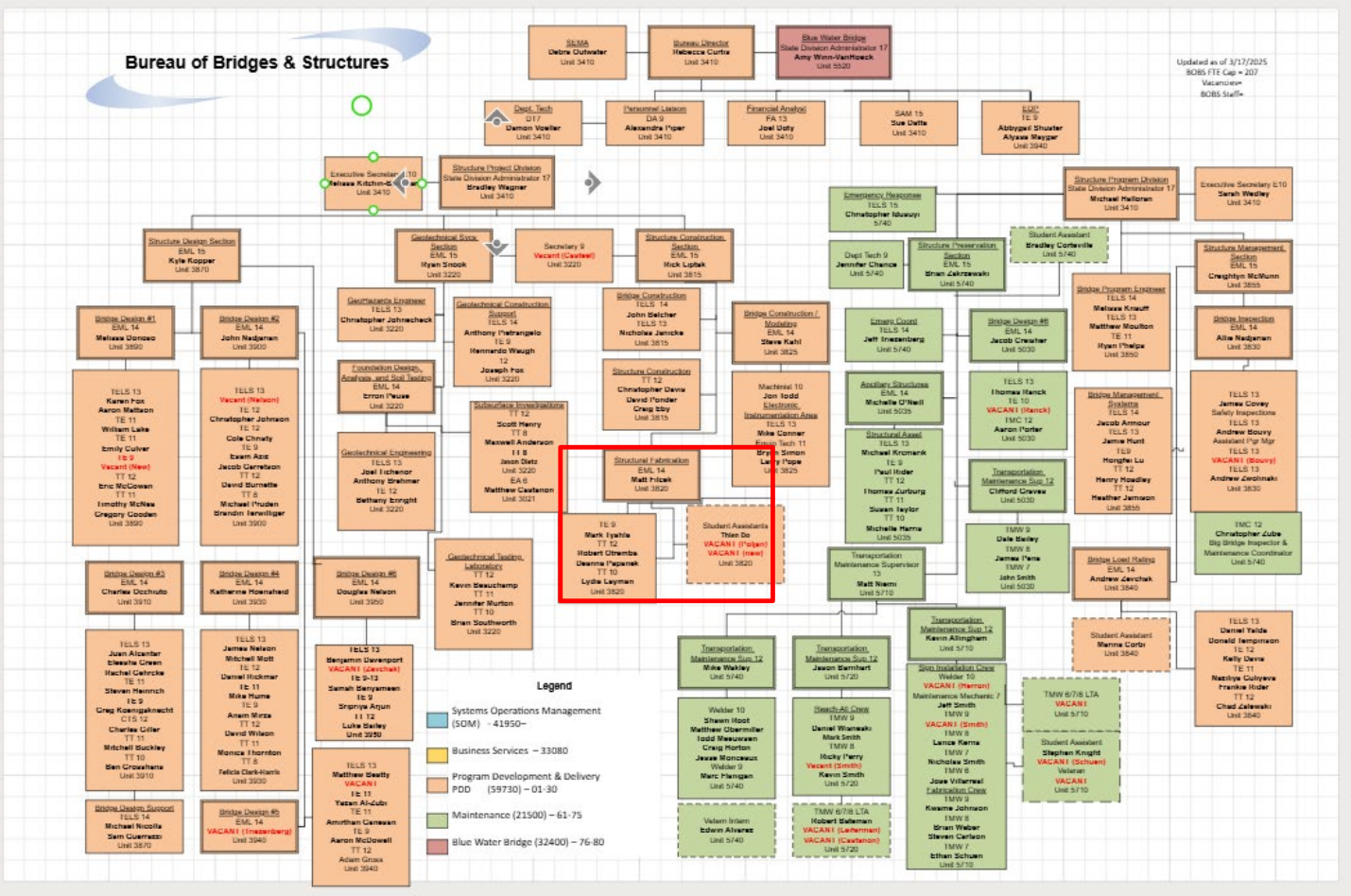
# FABRICATION QUALITY ASSURANCE PROCESS AND SHOP DRAWINGS

MDOT
Michigan Department of Transportation

BRIDGE WEEK - MARCH 18, 2026

# STRUCTURAL FABRICATION UNIT STAFF STRUCTURE

- **Rick Liptak,** Chief Bridge Construction Engineer
- **Matt Filcek,** Structural Fabrication Engineer
- **Mark Tyahla,** Staff Engineer
- **Bob Otremba,** Structural Steel Specialist
- **Deanna Papanek,** Structural Precast Concrete Specialist
- **Lydia Layman,** Transportation Technician
- Temporary/Seasonal Staff



# SAFETY MOMENT

- Filter lenses for radiant energy
- Start with a shade too dark
- Then move to a lighter shade

## Filter Lenses for Protection Against Radiant Energy

| | Electrode Size 1/32 inch | Arc Current | Minimum* Protective Shade |
|---|---|---|---|
| SMAW | Less than 3<br>3-5<br>5-8<br>More than 8 | Less than 60<br>60-160<br>161-250<br>251-550 | 7<br>8<br>10<br>11 |
| GMAW, FCAW | | Less than 60<br>60-160<br>161-250<br>251-500 | 7<br>10<br>10<br>10 |
| GTAW | | Less than 50<br>50-150<br>151-500 | 8<br>8<br>10 |
| Air Carbon Arc Cutting | Light<br>Heavy | Less than 500<br>500-1,000 | 10<br>11 |
| PAW | | Less than 20<br>20-100<br>101-400<br>401-800 | 6<br>8<br>10<br>11 |
| PAC | Light**<br>Medium**<br>Heavy** | Less than 300<br>300-400<br>401-800 | 8<br>9<br>10 |
| Torch Brazing, Torch Soldering, Carbon Arc Welding | | | 3<br>2<br>14 |

Electrode Size 1/32 inch

Arc Current

Minimum* Protective Shade

| | Plate Thickness (inches) | Plate Thickness (mm) | Minimum* Protective Shade |
|---|---|---|---|
| Gas Welding | Light: Under ¼<br>Medium: ¼-½<br>Heavy: Over ½ | Under 3.2<br>3.2-12.7<br>Over 12.7 | 4<br>5<br>6 |
| Oxygen Cutting | Light: Under 1<br>Medium: 1-6<br>Heavy: Over 6 | Under 25<br>25-150<br>Over 150 | 3<br>4<br>5 |

Plate Thickness (inches)

Plate Thickness (mm)

Minimum* Protective Shade

*As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.
**These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.

*Source: Occupational Safety and Health Administration (OSHA).*

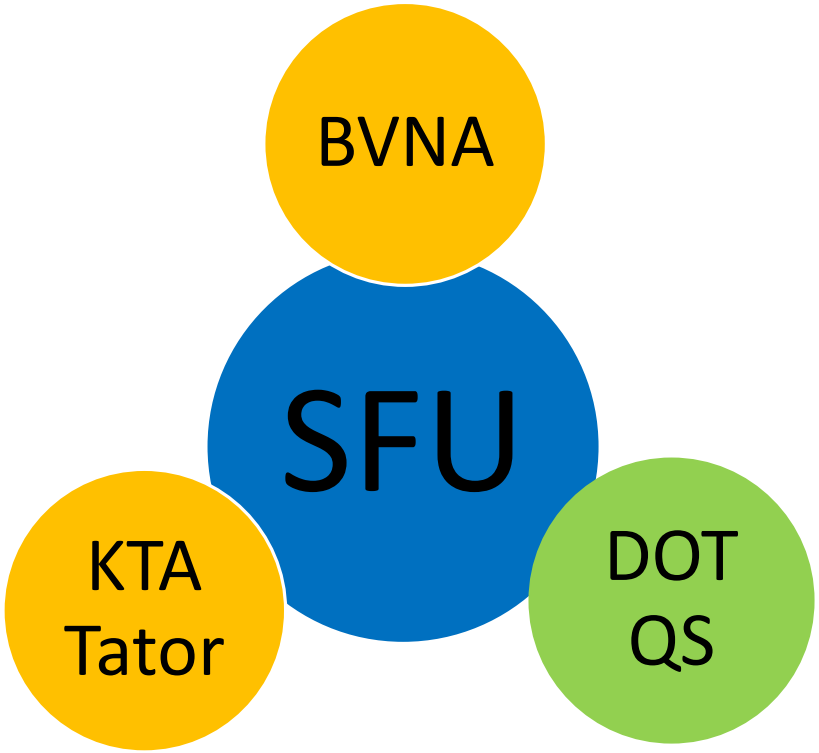
# MDOT'S FABRICATION QUALITY ASSURANCE TEAM

**KEY**

**Program Management & Fabrication Engineering**

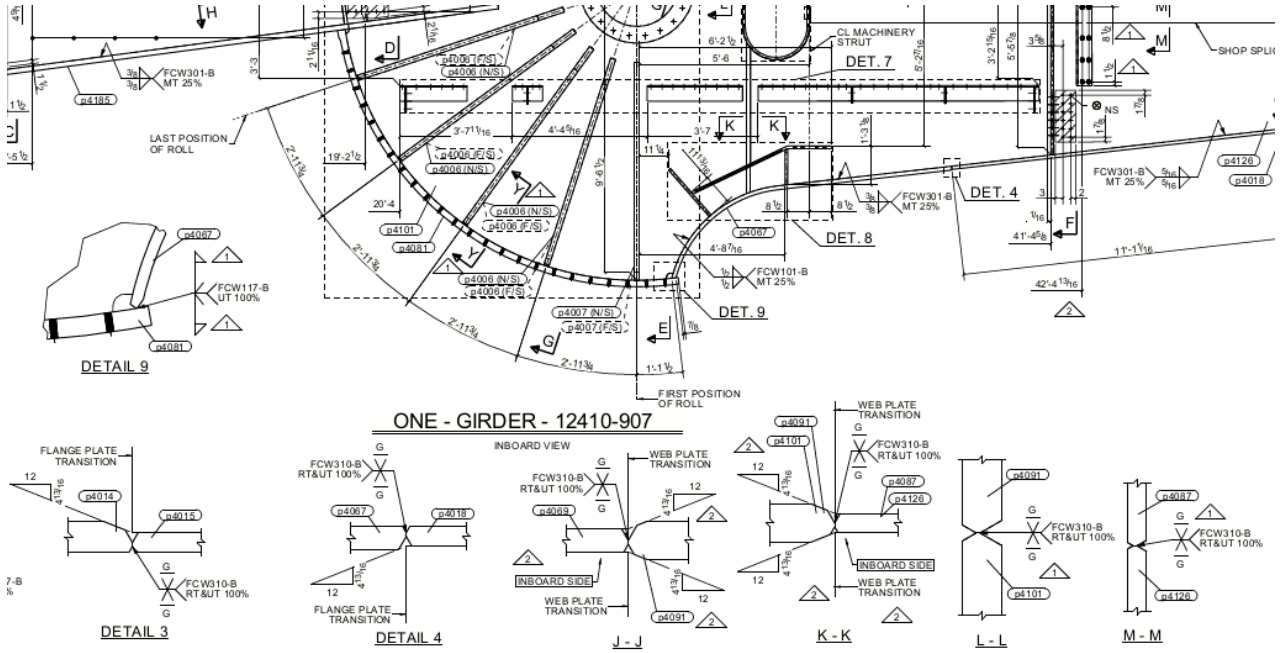
**Project Management & Fabrication Inspection**

**Quality Management & Fabrication Specialty Services**



# AGENDA

- Fabrication Quality Assurance (QA)
  - What is QA?
  - Why does MDOT perform QA?
- Shop Drawing Review
  - What are shop drawings?
  - Why does MDOT review them?




Lafayette bascule bridge segmental girder shop drawing.

# FABRICATION QUALITY ASSURANCE

## What is Quality Assurance (QA)?

## What is Quality Control (QC)?

# FABRICATION QUALITY ASSURANCE

## International Standard for Organization (ISO) 9000:2015

**Quality Assurance (QA):** Proactive part of quality management aimed at providing confidence that quality requirements will be fulfilled. QA involves planned and systematic activities across all stages of production or service delivery….QA emphasizes process improvement, risk reduction, and prevention of potential issues, which reduces costs and enhances customer satisfaction.

**Quality Control (QC):** Reactive part of quality management focuses on inspection, testing, and verification to ensure that products or services meet specified requirements. QC activities are typically applied after production or during critical checkpoints to detect defects and prevent nonconforming products from reaching customers.

# FABRICATION QUALITY ASSURANCE

## American Institute of Steel Construction (AISC)

**Quality Assurance (QA):** Refers to the systematic activities implemented within a quality system that provide confidence that a product or service will fulfill quality requirements. It focuses on the overall framework to ensure that quality management system requirements are met.

**Quality Control (QC):** Involves the operational techniques and activities used to fulfill quality requirements. It is a subset of QA that focuses on the inspection aspect of quality management.

# FABRICATION QUALITY ASSURANCE

## Prestressed/Precast Concrete Institute (PCI)

**Quality Assurance (QA):** Focuses on the overall quality of the process and the system, ensuring that all aspects quality management system are aligned with the required standards and best practices.

**Quality Control (QC):** Is more about the actual delivery of the product, where the focus is on inspecting and testing the final product to ensure it meets the specified quality criteria.

# FABRICATION QUALITY ASSURANCE

## National Precast Concrete Association (NPCA)

**Quality Assurance (QA):** The planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality. QA activities and responsibilities cover virtually all of the quality system in one fashion or the other.

**Quality Control (QC):** The operational techniques and activities used to fulfill requirements for quality. QC is a subset of the QA activities that focuses specifically on the operational activities used to fulfill quality management requirements.

# FABRICATION QUALITY ASSURANCE

## What is Quality Assurance (QA)?

**QA is proactive by focusing on prevention through process management to reduce risks and improve customer satisfaction by preventing defects in products.**

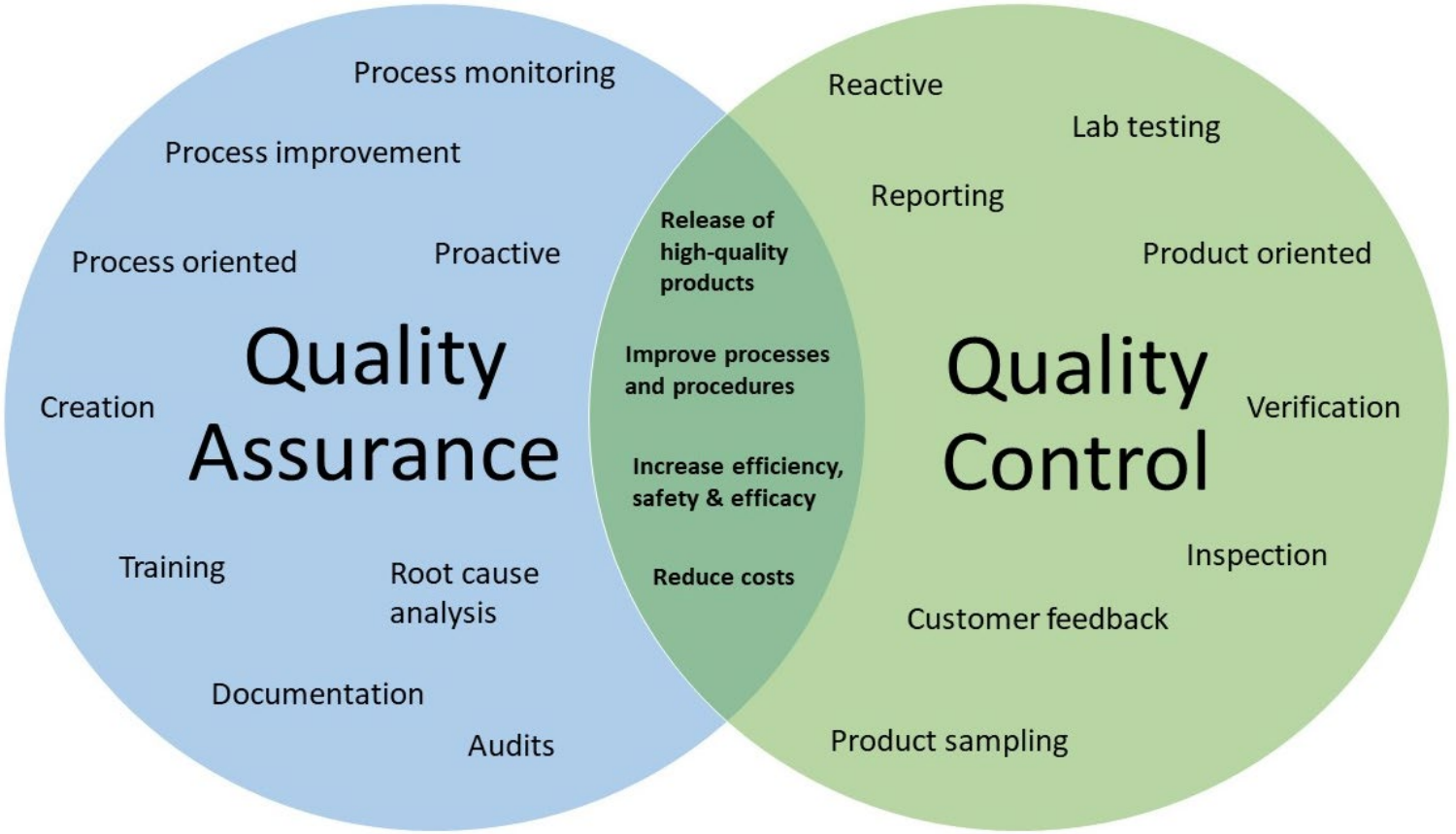
## What is Quality Control (QC)?

**QC is reactive by focusing on detection through inspection and testing to ensure products are free of defects.**

# FABRICATION QUALITY ASSURANCE

## QA & QC Venn Diagram:

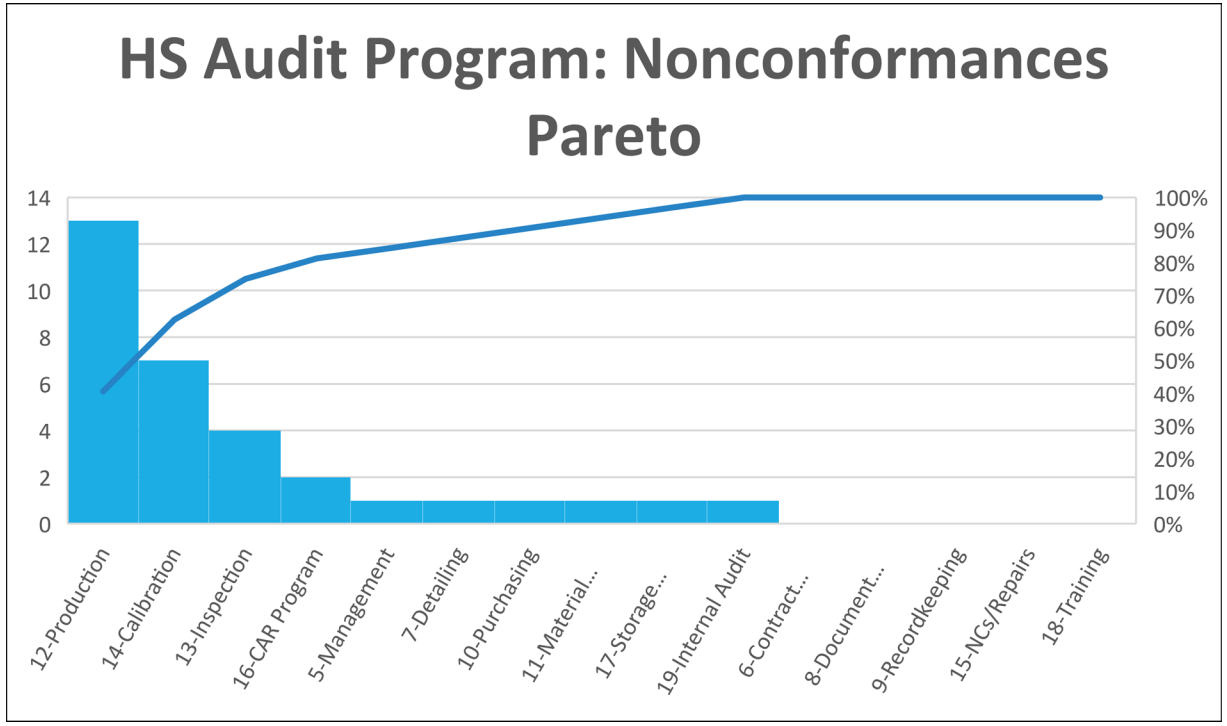
- High-quality products
- Improved processes & procedures
- Increase efficiency, safety, efficacy
- Reduce costs



# FABRICATION QUALITY ASSURANCE

## Why does MDOT perform QA?

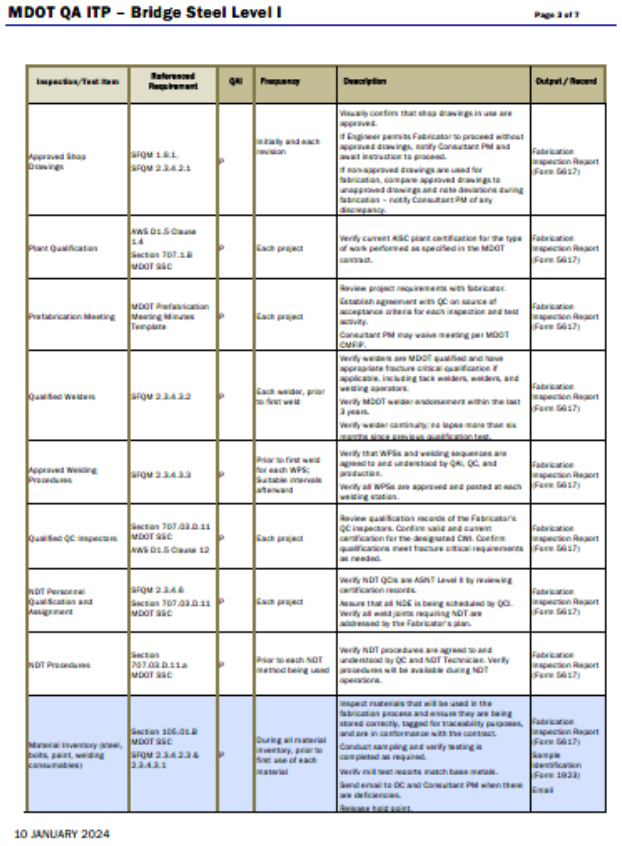
- Proactive to reduce project risk, improve product quality & customer satisfaction.
- QC does not prevent project quality issues.
- Prevention (QA) is a long-term solution.
- Detection (QC) is a short-term solution.
- MDOT's QA program is predicated on certified shops.



# FABRICATION QUALITY ASSURANCE

## Aspects of MDOT's QA Program:

- **Proactive:** MDOT QA performs shop drawing review, prefabrication meetings, fabricator procedure reviews, concrete IATs, welder qualification testing, concrete mix design review, WPS review, etc.
- **Process Oriented:** MDOT QA has detailed program/procedures (prefab meeting template, inspection procedures, inspection & test plans, inspection file checklists, supplier qualification standards, audit checklists, etc.).



**MDOT QA ITP – Bridge Steel Level I** Page 3 of 7

| Inspection/Test Item | Referenced Requirement | QAI | Frequency | Description | Output / Record |
|---|---|---|---|---|---|
| Approved Shop Drawings | SFQM 1.9.1.<br>SFQM 2.3.4.2.1 | P | Initially and each revision | Visually confirm that shop drawings in use are approved.<br>If Engineer permits Fabricator to proceed without approved drawings, notify Consultant PM and await instruction to proceed.<br>If non-approved drawings are used for fabrication, compare approved drawings to unapproved drawings and note deviations during fabrication – notify Consultant PM of any discrepancy. | Fabrication Inspection Report (Form 5617) |
| Plant Qualification | AWS D1.5 Clause 1.4<br>Section 707.1.B<br>MDOT SSC | P | Each project | Verify current AISC plant certification for the type of work performed as specified in the MDOT contract. | Fabrication Inspection Report (Form 5617) |
| Prefabrication Meeting | MDOT Prefabrication Meeting Minutes Template | P | Each project | Review project requirements with fabricator.<br>Establish agreement with QC on source of acceptance criteria for each inspection and test activity.<br>Consultant PM may waive meeting per MDOT CMFP. | Fabrication Inspection Report (Form 5617) |
| Qualified Welders | SFQM 2.3.4.3.2 | P | Each welder, prior to first weld | Verify welders are MDOT qualified and have appropriate fracture critical qualification if applicable, including tack welders, welders, and welding operators.<br>Verify MDOT welder endorsement within the last 3 years.<br>Verify welder continuity; no lapse more than six months since previous qualification test. | Fabrication Inspection Report (Form 5617) |
| Approved Welding Procedures | SFQM 2.3.4.3.3 | P | Prior to first weld for each WPS; Suitable intervals afterward | Verify that WPSs and welding sequences are agreed to and understood by QAI, QC, and production.<br>Verify all WPSs are approved and posted at each welding station. | Fabrication Inspection Report (Form 5617) |
| Qualified QC Inspectors | Section 707.03.D.11<br>MDOT SSC<br>AWS D1.5 Clause 12 | P | Each project | Review qualification records of the Fabricator's QC inspectors. Confirm valid and current certification for the designated CWI. Confirm qualifications meet fracture critical requirements as needed. | Fabrication Inspection Report (Form 5617) |
| NDT Personnel Qualification and Assignment | SFQM 2.3.4.6<br>Section 707.03.D.11<br>MDOT SSC | P | Each project | Verify NDT QCIs are ASNT Level II by reviewing certification records.<br>Assure that all NDE is being scheduled by QCI.<br>Verify all weld joints requiring NDT are addressed by the Fabricator's plan. | Fabrication Inspection Report (Form 5617) |
| NDT Procedures | Section 707.03.D.11.a<br>MDOT SSC | P | Prior to each NDT method being used | Verify NDT procedures are agreed to and understood by QC and NDT Technician. Verify procedures will be available during NDT operations. | Fabrication Inspection Report (Form 5617) |
| Material Inventory (steel, bolts, paint, welding consumables) | Section 105.01.B<br>MDOT SSC<br>SFQM 2.3.4.2.3 & 2.3.4.3.1 | P | During all material inventory, prior to first use of each material | Inspect materials that will be used in the fabrication process and ensure they are being stored correctly, tagged for traceability purposes, and are in conformance with the contract.<br>Conduct sampling and verify testing is completed as required.<br>Verify mill test reports match base metals.<br>Send email to QC and Consultant PM when there are deficiencies.<br>Reviews hold point. | Fabrication Inspection Report (Form 5617)<br>Sample Identification (Form 1923)<br>Email |

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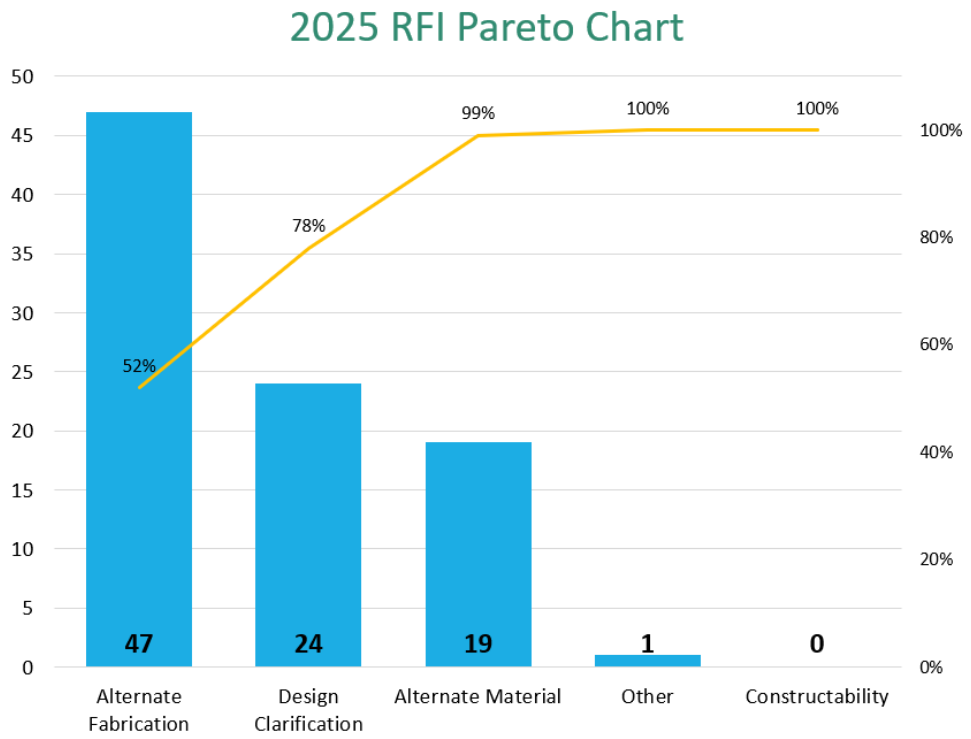
# FABRICATION QUALITY ASSURANCE

## Aspects of MDOT's QA Program (continued):

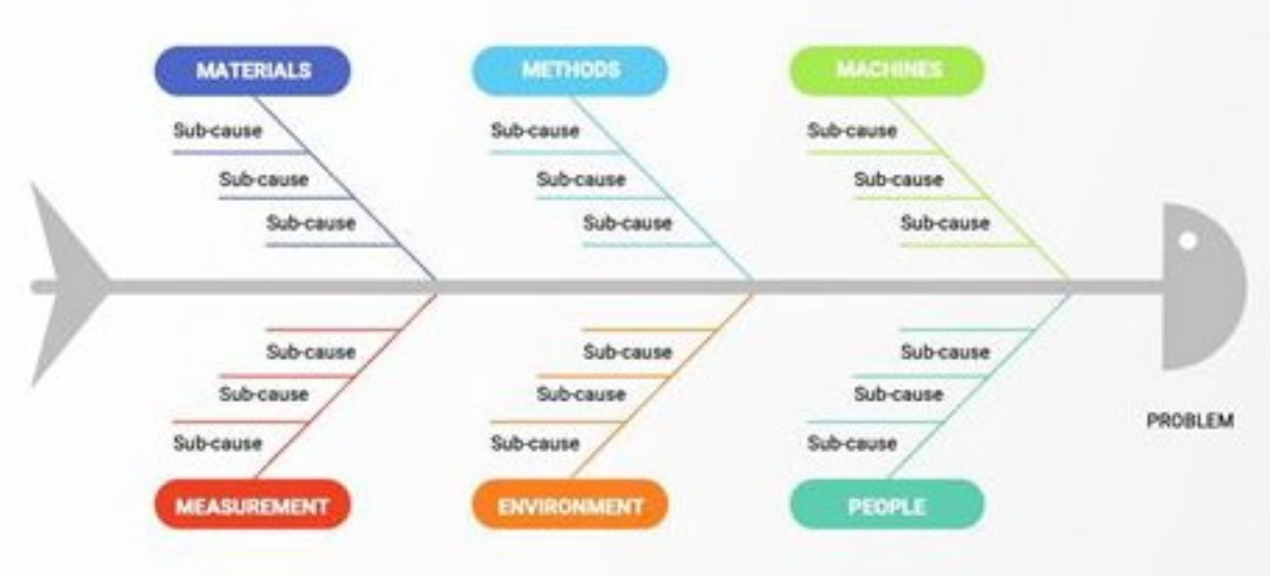
- **Documentation:** MDOT QA collects QC documents and stores files into fabrication inspection file. Provides traceability and evidence of compliance.
- **Audits:** MDOT QA performs supplier qualification audits and special immediate shop audits if QC is ineffective.

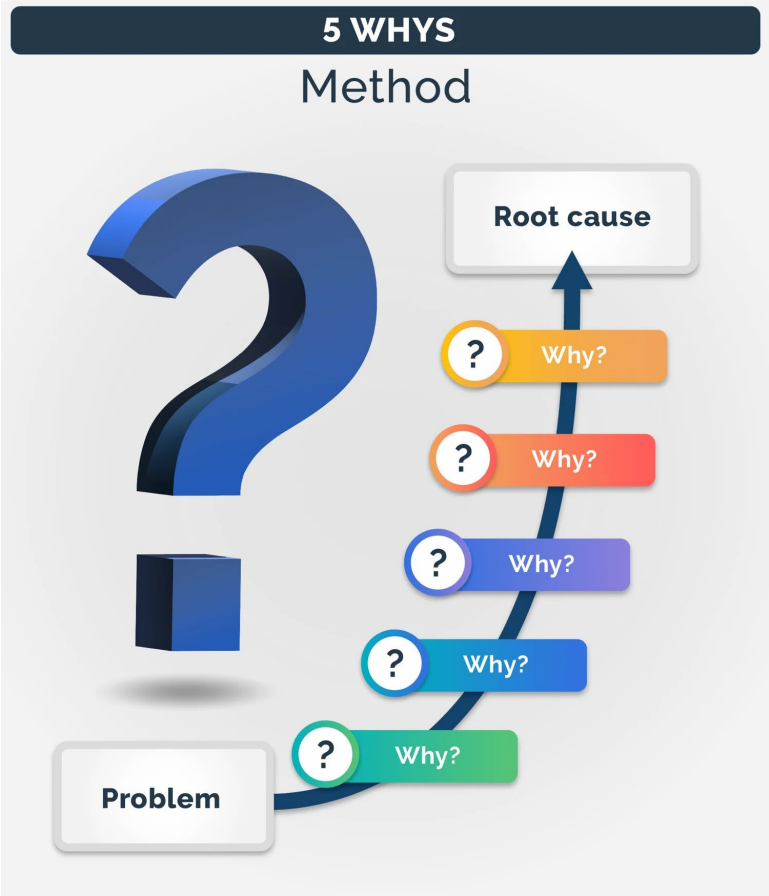


# FABRICATION QUALITY ASSURANCE

## Aspects of MDOT's QA Program (continued):

- **Root Cause Analysis:** Supplier performs root cause analysis if they self-issue or MDOT issues Corrective Action Requests (CAR). MDOT QA verifies root cause has been completed.

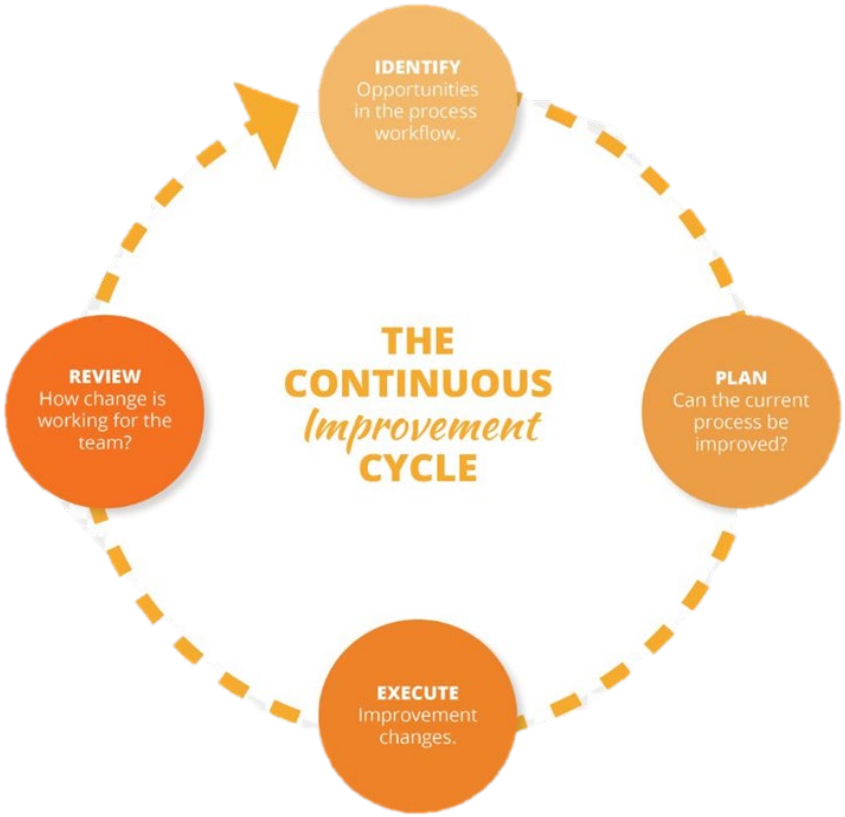


# FABRICATION QUALITY ASSURANCE

## Aspects of MDOT's QA Program (continued):

- **Process Improvements:** Supplier root cause analysis often leads to process improvements. MDOT QA reviews during CAR reviews and annual audits.
- **Training:** Supplier training is required to "implement" process improvements. MDOT QA verifies this has been completed if part of a MDOT QA CAR.



# FABRICATION QUALITY ASSURANCE

## Aspects of MDOT's QA Program (continued):

- **Process Monitoring:** Most shop inspection by MDOT's quality assurance inspector is monitoring QC and some inspection & testing that duplicates QC but intended to verify/check.

# FABRICATION QUALITY ASSURANCE

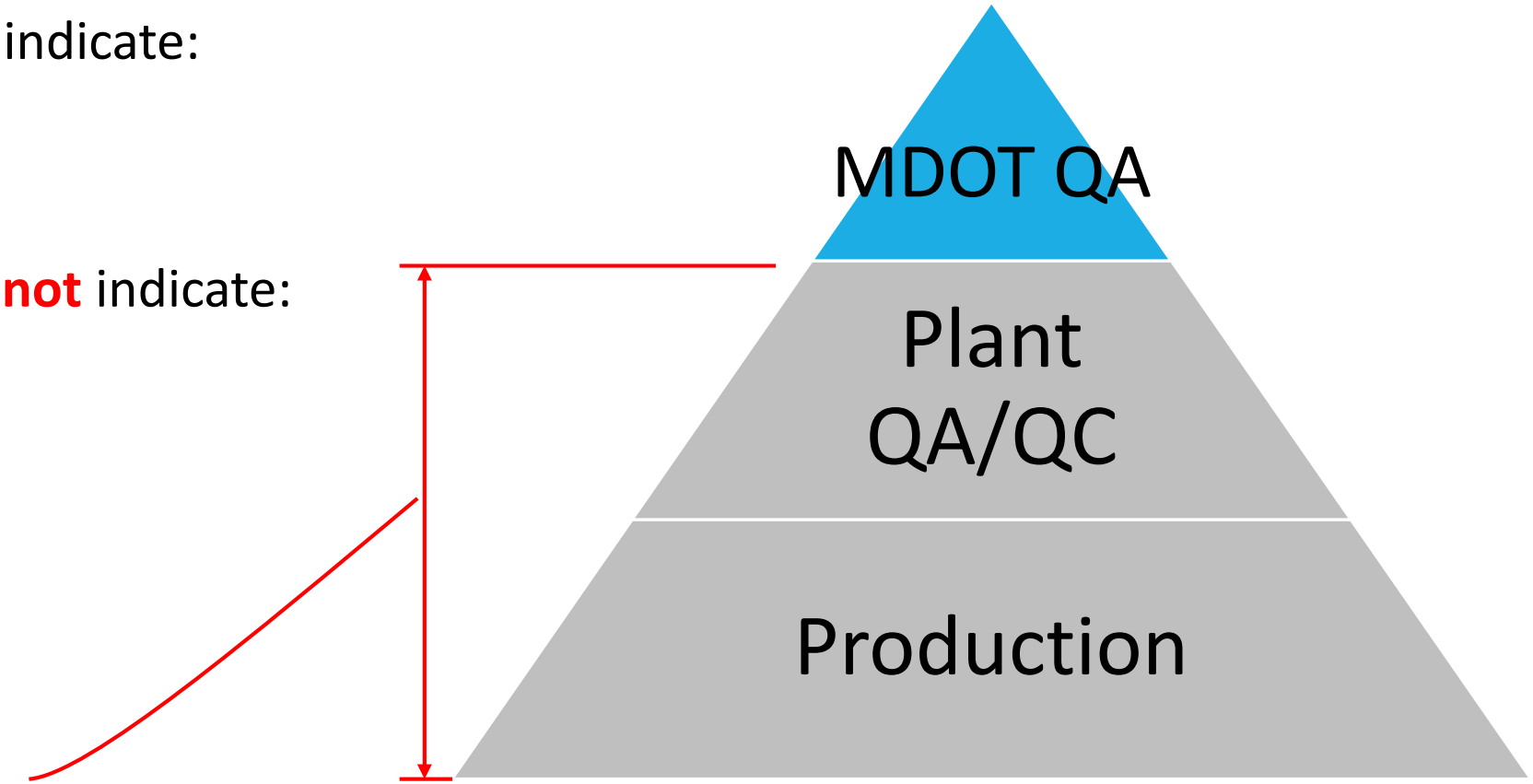
## Corrective Action Request (CAR)

Action to eliminate the cause of the detected nonconformity or other undesirable situation such as repetitive process control issues, severe or repetitive procedural violation, a severe customer complaint, or any internal/external audit finding. Action includes:

1. Identify quantity of affected product/materials
2. Containment (segregating, process-interruption, personnel stand-down)
3. Correct nonconformance
4. Identify root cause
5. Implement long-term verifiable action to prevent recurrence

# FABRICATION QUALITY ASSURANCE

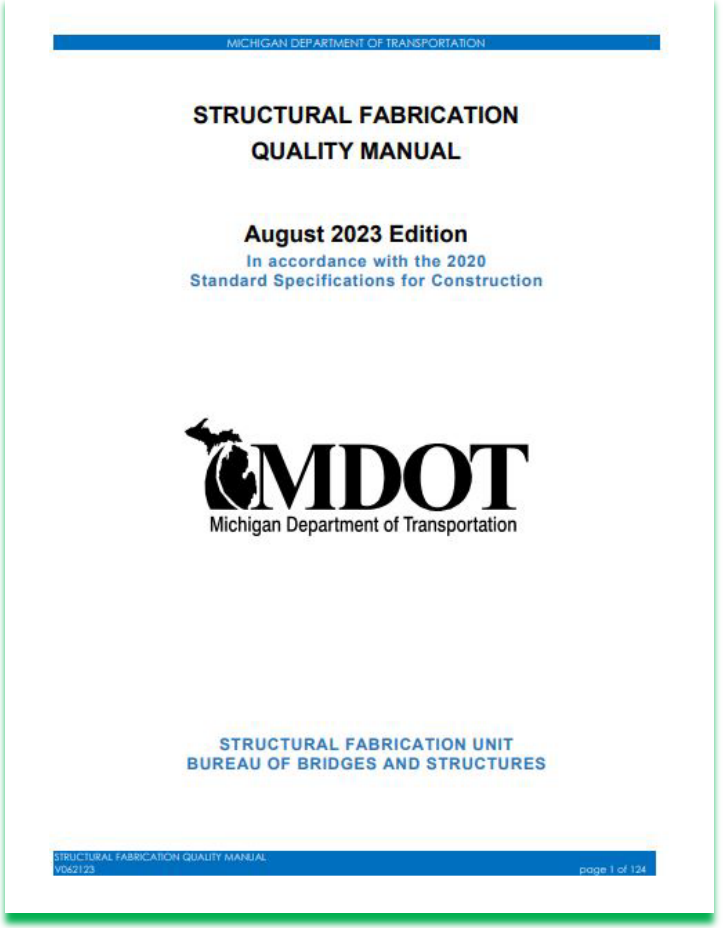
- Location of “MDOT QA” **does** indicate:
  - After QC
  - Least effort
- Location of “MDOT QA” **does not** indicate:
  - Responsibility
  - Ability to direct
  - Level of expertise




**Responsible to meet contract**

# FABRICATION QUALITY ASSURANCE

- Contract Documents
- MDOT Materials Quality Assurance Procedures Manual
- MDOT Structural Fabrication Quality Manual



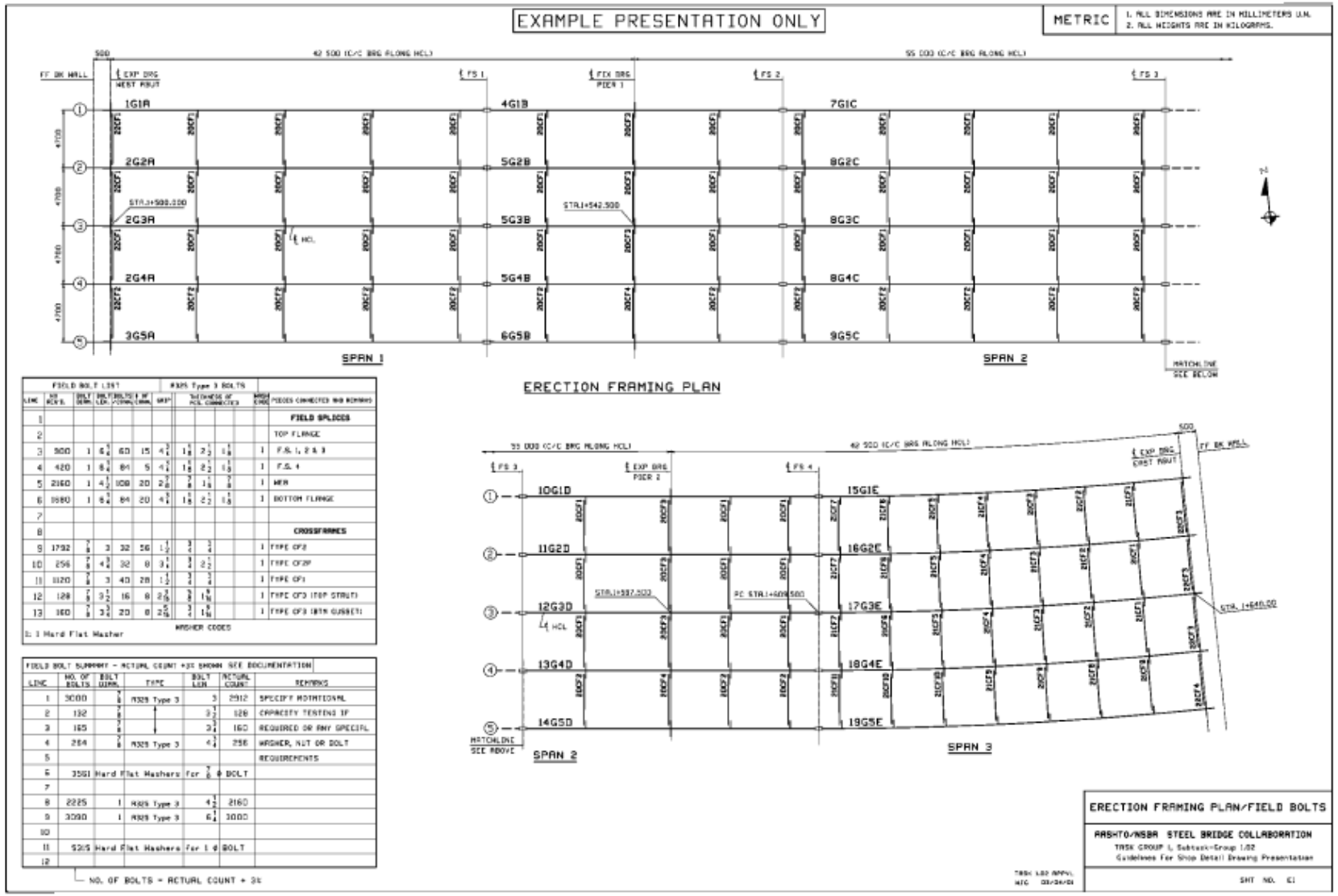
# FABRICATION QUALITY ASSURANCE

- Plant Certifications (ISO based):
  - Steel: AISC
  - Concrete: ACPA, NPCA, and PCI
  - Robust Quality Management Systems (plant QA & QC)
    - Internal annual audits
    - Internal management reviews
    - NCR & CAR triggers
    - External audits (plant certification company)
    - Continuous improvement

# SHOP DRAWING REVIEW

- What are shop drawings?

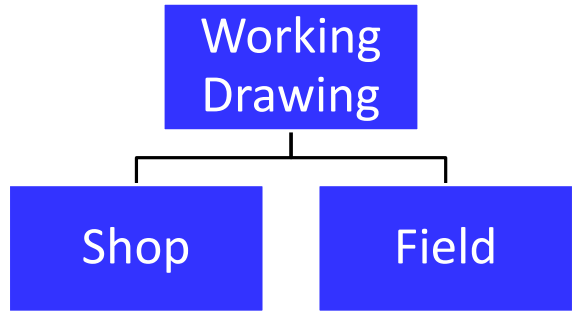
- Why does MDOT review them?

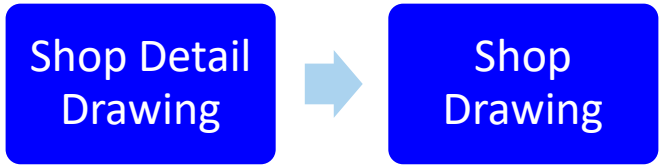



2026 BRIDGE WEEK

# SHOP DRAWING REVIEW

- Shop detail drawings are a type of working drawing.
- Turn contract plans and specifications into highly detailed technical plans that guide fabrication/manufacturing.
- Translate design intent into buildable instructions.
- Essential for ensuring accuracy, reducing errors, and improving coordination between trades during fabrication.
- Shop drawings may reference portions of the specifications.

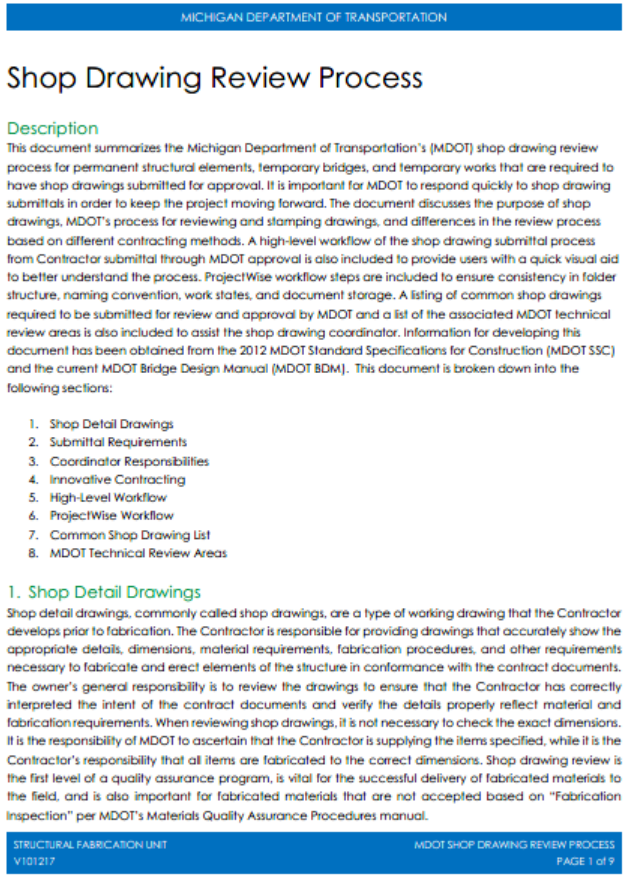


# SHOP DRAWING REVIEW

*"The Contractor must not deviate from the plans or from Department approved working drawings and design calculations unless the deviation is approved by the Engineer in writing"*

- Deviations to contract per subsection 104.03 of 2020 MDOT SCC
- Deviations cannot be "buried" in the SD
- Request for Information (RFI) is best practice for proposing deviations
- MDOT's Shop Drawing Review Process



MICHIGAN DEPARTMENT OF TRANSPORTATION

## Shop Drawing Review Process

### Description

This document summarizes the Michigan Department of Transportation's (MDOT) shop drawing review process for permanent structural elements, temporary bridges, and temporary works that are required to have shop drawings submitted for approval. It is important for MDOT to respond quickly to shop drawing submittals in order to keep the project moving forward. The document discusses the purpose of shop drawings, MDOT's process for reviewing and stamping drawings, and differences in the review process based on different contracting methods. A high-level workflow of the shop drawing submittal process from Contractor submittal through MDOT approval is also included to provide users with a quick visual aid to better understand the process. ProjectWise workflow steps are included to ensure consistency in folder structure, naming convention, work states, and document storage. A listing of common shop drawings required to be submitted for review and approval by MDOT and a list of the associated MDOT technical review areas is also included to assist the shop drawing coordinator. Information for developing this document has been obtained from the 2012 MDOT Standard Specifications for Construction (MDOT SSC) and the current MDOT Bridge Design Manual (MDOT BDM). This document is broken down into the following sections:

1. Shop Detail Drawings
2. Submittal Requirements
3. Coordinator Responsibilities
4. Innovative Contracting
5. High-Level Workflow
6. ProjectWise Workflow
7. Common Shop Drawing List
8. MDOT Technical Review Areas

### 1. Shop Detail Drawings

Shop detail drawings, commonly called shop drawings, are a type of working drawing that the Contractor develops prior to fabrication. The Contractor is responsible for providing drawings that accurately show the appropriate details, dimensions, material requirements, fabrication procedures, and other requirements necessary to fabricate and erect elements of the structure in conformance with the contract documents. The owner's general responsibility is to review the drawings to ensure that the Contractor has correctly interpreted the intent of the contract documents and verify the details properly reflect material and fabrication requirements. When reviewing shop drawings, it is not necessary to check the exact dimensions. It is the responsibility of MDOT to ascertain that the Contractor is supplying the items specified, while it is the Contractor's responsibility that all items are fabricated to the correct dimensions. Shop drawing review is the first level of a quality assurance program, is vital for the successful delivery of fabricated materials to the field, and is also important for fabricated materials that are not accepted based on "Fabrication Inspection" per MDOT's Materials Quality Assurance Procedures manual.

STRUCTURAL FABRICATION UNIT — MDOT SHOP DRAWING REVIEW PROCESS
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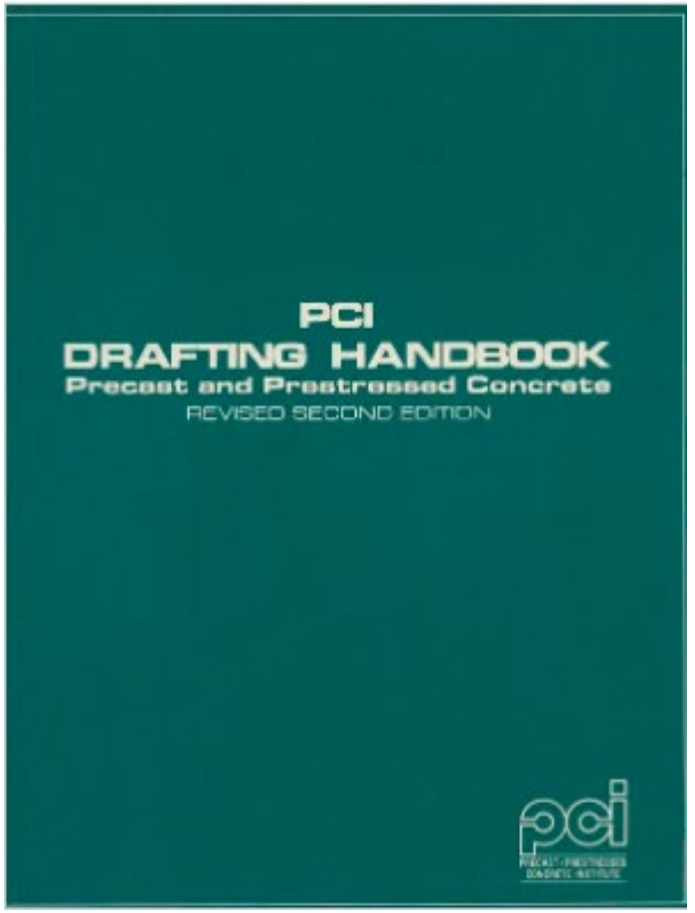
# SHOP DRAWING REVIEW

- Industry Drafting Standard References:

  - Precast/Prestressed Concrete Institute (PCI) MNL 119 *Drafting Handbook, Precast and Prestressed Concrete 2nd Ed. 1990 (1st Ed. 1975)*
  - National Steel Bridge Alliance (NSBA) *Shop Detail Drawing Presentation Guidelines G1.3:2002*
  - NSBA *Shop Detail Drawing Review/Approval Guidelines for Fabricated Structural Steel G1.1-2020*



# SHOP DRAWING REVIEW

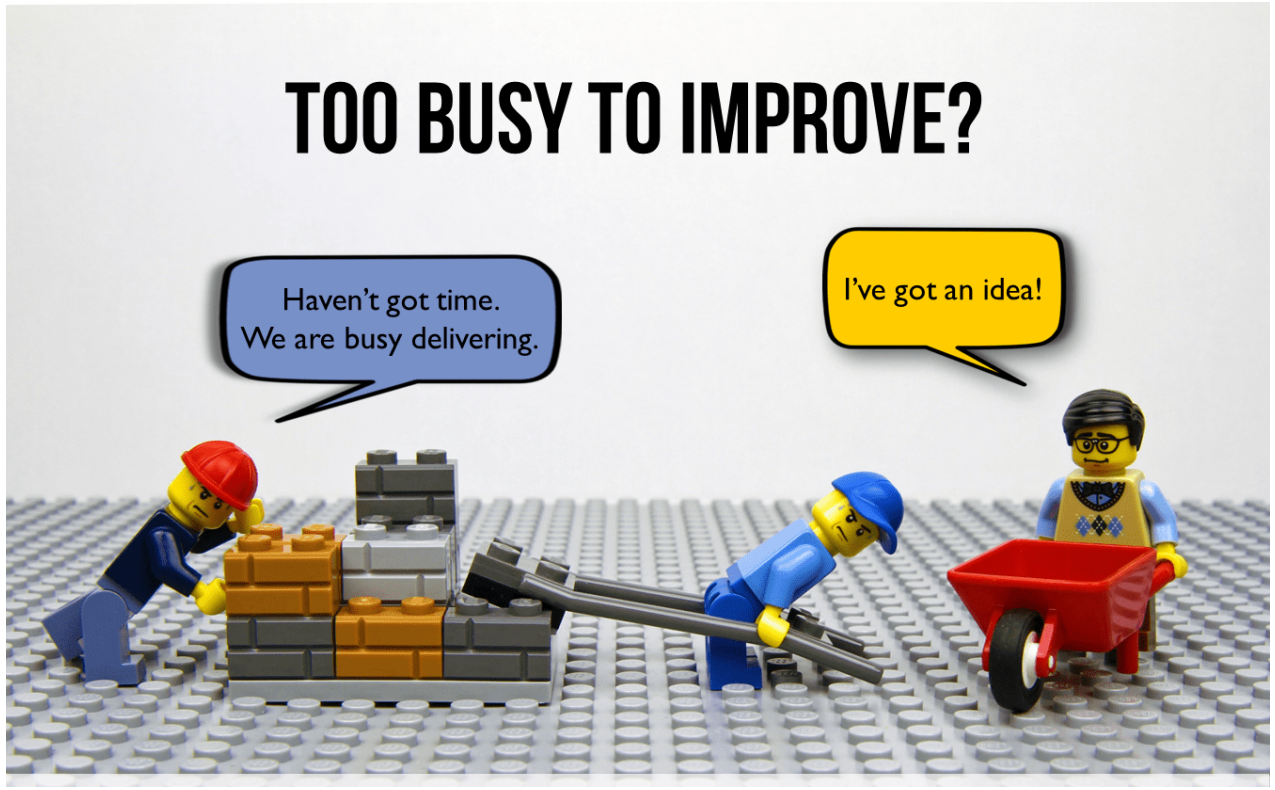
What MDOT's shop drawing approval stamp used for?

- Document control
- Communication between MDOT and shop inspector
- Division 1 of MDOT spec book:

*"The Department's review and approval does not relieve the Contractor of full responsibility for all negligence in the construction of he project resulting from the working drawings. The Department's review and approval of the working drawings and design calculations are not a warranty of the adequacy and correctness of the design"*

Above language has been reviewed and supported by MDOT's Attorney General Office.

# QUESTIONS?


TOO BUSY TO IMPROVE?
Haven't got time.
We are busy delivering.
I've got an idea!