MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
COMPLEX STEEL ERECTION, SHORING AND FALSEWORK

STR:BMW 1 of 5 APPR:JAB:SCK:03-17-25
FHWA:APPR:03-24-25

a. Description. This work consists of furnishing the design, erection plans for the erection of straight or curved steel girders and other bridge elements in various statical configurations, including but not limited to any necessary temporary foundations, tie-downs, counterweights, bracing, falsework or shoring required to ensure global static equilibrium, and allowable element stresses at all phases of erection. Furnish all work and materials for installing, maintaining, modifying, or adjusting, and removing temporary foundations, tie-downs, counterweights, bracing, falsework or shoring in accordance with section 707 of the Standard Specifications for Construction, the *AASHTO LRFD Bridge Design Specifications (hereafter referred to as AASHTO Design),* and the *AASHTO Guide Design Specifications for Bridge Temporary Works*, except as modified herein.

Furnish all elements in accordance with subsections 104.02 and 706.03 of the Standard Specifications for Construction and as specified herein.

b. Definitions.

Falsework. Any temporary construction work used to support the permanent structure until it becomes self-supporting. Falsework may include steel or timber beams, girders, columns, piles and foundations, and any proprietary equipment including modular shoring frames, post shores, and adjustable horizontal shoring. Shoring is a component of falsework such as horizontal, vertical, or inclined support members.

Temporary Support. A component of falsework, typically a steel column and timber/steel plate footing arrangement similar to the “Detail of Temporary Supports from Below” as provided in the *MDOT Bridge Design Manual*.

Primary Members. Structural elements that are designed to carry live load and act as primary load paths. Examples include beams, girders, bents, truss chords, rigid frames, bearing stiffeners, and falsework which carry live load. Additionally, lateral connections such as gusset plates and curved-girder cross-frames are considered primary members. Primary member is considered synonymous with the term “main member”.

Secondary Members. Structural elements which do not carry primary stress or act as a primary load path.

c. Submittals.

Submit erection plans and design calculations, foundation support plans and design calculations to the Engineer for review and approval prior to beginning work, including shop drawings for all temporary shoring, bracing, supports, temporary foundations, and falsework. The Department will

have up to 14 calendar days to review for approval or provide comments for revisions required to obtain approval unless noted otherwise in the contract. Should approval not be granted per the first review, the Contractor is required to submit a revised erection plan and design calculations, and the Department may require up to 7 calendar days for each additional review cycle.

Do not begin any field work associated with complex erection, or any required foundation supports until approval is received from the Engineer.

The Department's review and approval does not relieve the Contractor of full responsibility for all negligence in the construction of the project resulting from any submittals required herein. The Department's review and approval are not a warranty of the adequacy and correctness of the submittals.

1. Erection Plan. Submit erection plans and design calculations and design calculations to the Engineer for review and approval, including shop drawings for all temporary shoring, bracing, supports, and falsework.

Retain the services of a Professional Engineer, licensed in the State of Michigan, prequalified in Design - Bridges: Complex to prepare, sign, and seal an erection plan and calculations for the erection of the structural steel.

Alternately, the Contractor may use an engineer that is not prequalified in Design - Bridges: Complex if the erection engineer is licensed in the State of Michigan and has developed a minimum of 3 complex steel girder erection plans of similar scope in the last 7 years. If the Contractor elects to utilize a non-prequalified erection engineer, it is the Contractor's responsibility to provide an erection engineer that meets these requirements and obtain approval by the Engineer of the non-prequalified erection engineer. Failure to obtain approval will not be reason for delays, extensions of time or additional compensation.

For non-prequalified erection engineers submit the following information for previous projects to the Engineer for review:

- Owner's contract number
- Project description
- Project manager's name and current telephone number
- Signed and sealed erection plans.

Design of temporary foundations and falsework determined necessary by the Contractor's engineer, must be included in the erection plan. As a minimum, the erection plan must include:

- Erection drawings, including falsework, including scaled plan of work showing supporting structure, roads, railroad, waterways, overhead and underground utilities, adjacent structures, etc., and falsework plan.
- Calculations for load capacity and stability of all falsework.
- Calculations substantiating structural integrity and stability of all members for each stage of the complex erection.
- Calculations substantiating structural integrity of abutment and retaining wall surcharges due to placement of cranes, temporary supports, and falsework.
- Details of temporary connections to permanent structural elements for the purposes of erection, and calculations substantiating structural integrity.

- Details of repairs of temporary connections upon removal of such connections after completed complex erection.
- Calculations substantiating that the factored construction stresses satisfy the requirements of all applicable limit states of *AASHTO Design*.
- Assumption and/or verification of construction loadings, wind loadings, and application of the appropriate load factors and limit state checks.
- Global static equilibrium calculations via refined analysis.
- Permanent and temporary structural member and/or node demand/capacity and stress calculations.
- Procedures for repair of temporary connection points to permanent members.
- Location of temporary supports, falsework, and cranes.
- Falsework and temporary support details.
- Bracing required to address member differential deflections, lateral torsional buckling, etc.
- Bracing required to address potential fascia beam lateral torsional buckling, or out of plane bending due to wide deck overhang pour (greater than 3 feet-6 inches) prior to achieving composite action.

The erection documents must indicate, at a minimum, a detailed sequence for:

- Written procedure indicating erection sequence for primary and secondary members and all temporary supports and falsework. Include method of tie downs for elements, connection of diaphragms, lateral bracing, and field splices. Ensure the erection procedure is in accordance with the *AASHTO Design* and *AASHTO LRFD Bridge Construction Specifications*.
- Achieving the appropriate member geometry, camber, and deflection at all phases of erection, and ensuring final configuration geometry is achieved.
- Use and placement of each falsework item, including when they will be installed and removed.
- Member delivery location.
- Location of crane(s) positions on plans indicating pick radii.
- Details of member rigging, including sizes, weights of members, capacities, crane capacity chart and location of center of gravity of each pick.
- Subassembly of the girders, and other permanent structural members.
- Installation of all bearing anchor bolts, and bearings and the fixity provided by each bearing during each stage of the erection.
- Erection of the girders on a girder by girder and span by span basis.
- When each cross frame/diaphragm is placed, including those over the supports.
- When each cross frame/diaphragm connection bolt is installed and when and to what degree they are tightened.
- Procedure for managing time rate of settlement for temporary foundations.
- Establishment of member/connection tolerances at all phases of erection, along with inspection/hold points/non-conformance process should tolerances be exceeded.

Furnish supporting calculations demonstrating that every member and connection of the permanent structure are within all applicable *AASHTO Design* limit state stresses during all phases of erection. Ensure not to damage the proposed permanent elements. If stiffeners are required at temporary support points, design, and detail these as permanent structural elements to be added as part of the initial fabrication (not installed in the field) at no additional cost to the contract. These elements and connections will be of the same structural material grades, and subject to all *AASHTO Design* requirements.

2. Foundation Support Plan. Submit foundation support plan and design calculations to the Engineer for review and approval, including working drawings for all temporary foundations.

Retain the services of a Licensed Engineer in the State of Michigan, prequalified in Design: Geotechnical-Advanced to perform geotechnical services associated with the design, and to prepare, sign, and seal plans and calculations of the temporary foundation supports at each location necessary for the construction/erection of the permanent structural elements. Assumptions are that the falsework supports will be a steel column and timber footing arrangement similar to the "Detail of Temporary Supports from Below" as provided in the *MDOT Bridge Design Manual*. Also, the falsework supports will be bearing on natural ground or sand backfill; existing pavement will be removed to expose natural ground, when necessary.

Determine bearing capacities on a site-by-site basis after the initial design of the falsework system is furnished and exact locations of temporary foundation supports have been established. Furnish supporting data and calculations for temporary foundation settlements, bearing resistances and geotechnical global stability of adjacent features, sealed by a Professional Engineer licensed in the State of Michigan, for approval.

d. Materials. Furnish materials that meet the requirements of the following sections of the Standard Specifications for Construction:

Structural Steel.....906
High Strength Steel Bolts, Nuts, and Washers.....906
Structural Timber and Lumber.....912
Miscellaneous Metals.....908
Granular Material Class II, III.....902
Concrete, Grades 3500, 4500.....1004
Mortar and Grout.....1005
Steel Reinforcement.....905

e. Construction. Perform all work in accordance with section 707 of the Standard Specifications for Construction. Do not order materials or begin work on the complex erection until approved by the Engineer. All costs associated with damages, rejection of materials and equipment, or removal of completed work prior to the approval of the Engineer will be borne by the Contractor.

During construction, the Contractor must take into account such items as:

- Soil conditions and temporary foundation effects on global stability of adjacent features.
- Estimated total settlement for temporary foundations.
- Estimated time rate of settlement for temporary foundations.
- Factored bearing resistance for temporary foundations.
- The need for additional soil borings to support design of temporary foundations.
- Sequencing.
- Stability of falsework and primary members.
- Wind loading.
- Crane size and placement.
- Pick point.
- Girder or member shape.

- Girder or member deformation and roll.
- Cross frame/diaphragm connections.
- The use of oversize holes or slots.
- Blocking of bearings.
- Plumbness.
- Thermal gradient effects on shoring and temporary support structures.
- Additional construction loadings such as equipment, work platforms, etc.

Supporting calculations must also demonstrate that every member and connection of the permanent structure are within all applicable *AASHTO Design* limit state stresses during all phases of erection. Ensure not to damage the proposed permanent members. If stiffeners are required at temporary support points, design, and detail these as permanent structural elements to be added as part of the initial fabrication (not installed in the field) at no additional cost to the contract.

f. Measurement and Payment. The completed work, as described, will be measured as a lump sum and paid for at the contract price using the following pay item:

Pay Item	**Pay Unit**
Complex Steel Erection (Structure Identification)	Lump Sum

Complex Steel Erection (Structure Identification) includes designing and detailing the erection plan, foundation support plan and erecting the girders or other elements.

Complex Steel Erection (Structure Identification) also includes all costs associated with designing, fabricating, installing, monitoring, maintaining, and removing temporary foundations and falsework required during the construction of the new bridges. Expenses incurred due to revisions to submitted documents prior to obtaining Engineer's approval are included in the payment. No additional compensation will be made for delays caused by modifications or revisions to the submitted documents prior to obtaining approval by the Engineer.