

501.03

49 prints of each revised drawing. Once the Engineer accepts shop drawings,
50 one set of accepted drawings will be returned to the Contractor. Prepare and
51 submit shop drawings at no increase in contract price or contract time.
52 Changes to accepted shop drawings without written consent of the Engineer
53 will not be allowed. Steel fabrication before shop drawing acceptance by the
54 Engineer will not be allowed.

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56 Submit shop drawings not less than four weeks prior to fabrication.
57 Make corrections in a timely manner.

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Shop drawings shall include the following:

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61 **(1)** Details for connections not dimensioned in the contract
62 documents.

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64 **(2)** Direction of rolling of plates where the contract documents
65 require specific orientation.

66

67 **(3)** Sequence and procedures.

68

69 **(4)** Location of butt-welded splices on layout drawing of entire
70 structure.

71

72 **(5)** Calculations and location of temporary supports and vertical
73 alignment of members at each stage of fabrication.

74

75 **(6)** Slip-critical connections and connections subject to direct
76 tension.

77

78 **(7)** Qualifications of welders in accordance with Section 5, Part B,
79 of AWS D1.5.

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81 **(8)** Qualifications of welding inspectors in accordance with Section
82 6, Part A, of AWS D1.5.

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(B) Required Prints and Reports. Submit drawings and reports in accordance with Table 501.03-1 - Submittal Requirements.

TABLE 501.03-1 – SUBMITTAL REQUIREMENTS		
Item	Number of Sets Required	Furnish To
Preliminary Shop Drawings	6	Engineer
Final Shop Drawings	10	Engineer
Mill Orders and Test Reports	5	Engineer
Notice of Placing Shop Order	2	Engineer
Notice of Beginning Shop Work	3	Shop Inspector
Match Mark, Camber, and Erection Diagrams	1 8	Shop Inspector Engineer
Shipping Statements	1 4	Shop Inspector Engineer
Report of Full-Size Tests	1 6	Shop Inspector Engineer
Record of Annealing Charges	6	Engineer

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(C) Mill and Shop Inspection. Give advance notice of shop and mill work, and work locations to the Engineer so testing and inspectional procedures may be prepared.

Furnish facilities for inspection of material and workmanship in mill and shop. Allow inspectors free access to necessary parts of work.

When the Engineer requires test specimens or certifications, furnish specimens and certifications at no increase in contract price or contract time.

(D) Shop Work and Fabrication. Keep structural material clean and free from damage caused by improper handling during loading, transporting, and storage.

Furnish and follow methods and procedures for preparation, handling and inspection, shop assembly of material, and details of fabrication

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104 conforming to Section 6 - Steel Structures, in AASHTO *LRFD Bridge Design*
105 *Specifications*.

106

107 Furnish and perform methods and procedures for shop and field
108 welding in accordance with AWS D1.5 and AASHTO *LRFD Bridge Design*
109 *Specifications*. Furnish and perform methods and procedures for welding of
110 structural supports for highway signs, luminaires, traffic signals, and other
111 non-bridge structures in accordance with AWS D1.1.

112

113 Electro-slag welding will not be allowed.

114

115 Furnish and perform methods and procedures for welding of
116 reinforcing steel conforming to AWS D1.4 and Subsection 602.03(E) -
117 Splicing of Bars.

118

119 Zinc coat all structural steel, excluding steel for major steel bridges
120 that receive paint finishes.

121

122 **(E) Erection.**

123

124 **(1) General.** The Engineer will inspect erection work. Provide
125 access to facilities for thorough inspection of erection work, including
126 materials used and quality involved.

127

128 **(2) Plant.** Use falsework, tools, machinery, and appliances,
129 including drift pins and fitting-up bolts, necessary for handling of work.

130

131 **(3) Handling and Storing Materials.** Place materials on skids
132 above ground. Keep storage area clean and properly drained. Place
133 girders and beams upright and shored, supporting long members such
134 as columns and chords on skids. Place skids close enough together
135 to prevent damage from deflection.

136

137 **(4) Falsework.** Design, construct, and maintain falsework to
138 handle required loads. Submit plans and calculations for falsework
139 stamped and signed by Hawaii Licensed Structural Engineer.
140 Acceptance of the Contractor's plans by the Engineer does not relieve
141 the Contractor of responsibility for correctness and completeness of
142 drawings and for fit of shop and field connections.

143

144 Place and protect falsework for steel structures on footing that
145 is protected from undermining and softening subsurface conditions.
146 Set falsework to give structural camber required by the contract
147 documents or ordered by the Engineer. Brace top of all falsework,
148 excluding blocking, transversely.

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150 Install falsework lighting in accordance with Section 633 –
151 Falsework Lighting.

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(5) Methods and Equipment. Before erection begins, submit proposed method of erection and proposed number and character of equipment. Submit erection procedures prepared, stamped, and signed by Hawaii Licensed Structural Engineer who is familiar with heavy rigging. Do not begin work until written acceptance is received from the Engineer.

(6) Bearing and Anchorages. Do not place masonry bearing plates upon bridge seat bearing areas that are improperly finished, deformed, or irregular. Set bearing plates level in exact positions with full and even bearing upon masonry. Place bearing plates on fabric or elastomeric pads as indicated in the contract documents.

Set anchor bolts accurately in drilled or cast holes, except when bolts are built into masonry and fixed by completely filling forms with portland cement concrete. Provide location of anchor bolts in relation to slotted holes in expansion shoes, corresponding with temperature at time of erection. Adjust nuts on anchor bolts at expansion ends of spans.

(7) Straightening Bent Materials. Straighten plates, angles, and other shapes by methods that will not produce fracture or other damage. Do not heat metal unless permitted by the Engineer. When heating is permitted, control heating temperature so as not to produce metal of dark "cherry red" color. After heating, cool metal as slowly as possible. Submit proposed straightening procedures and inspection methods stamped and signed by Hawaii Licensed Structural Engineer.

After straightening bends or buckles, inspect metal carefully for fractures, by method other than visual, that is acceptable to the Engineer. Restore finish of straightened materials.

(8) Assembling Steel. Assemble parts accurately, following match-marks. Handle materials carefully so as not to bend, break, or damage parts. Hammering that may damage or distort members will not be allowed. Clean bearing surfaces, as well as surfaces in permanent contact, before assembling members. Unless built by cantilever method, build truss spans on blocking placed to give trusses proper camber. Leave blocking in place until tension chord splices are fully connected, and then pin and bolt all other truss connections. Do not tighten railing bolts, or those in splices of compression member butt joints, or bolts in railings until the span has been swung. Use splices and field connections with 1/2 of holes filled with bolts and 1/2 with cylindrical erection pins before placing permanent fasteners. For splices and connections carrying traffic during erection, fill 3/4 of holes with bolts.

200 **(9) Pin Connections.** Furnish pilot and driving nuts for use in
201 driving pins at no increase in contract price or contract time. Drive
202 pins so that members take full bearing on pins. Screw pin nuts tight
203 and burr threads at face of nut with pointed tool.
204

205 **(10) Misfits.** The Engineer will consider correction of minor misfits
206 involving harmless quantities of reaming, cutting, and chipping as part
207 of erection process. Immediately report to the Engineer errors in shop
208 fabrication or deformation resulting from handling and transport of
209 material. Obtain the Engineer's acceptance regarding method of
210 correcting error. Correction of misfits, errors, injuries, and
211 replacements shall be the Contractor's responsibility.
212

213 **(11) Bolted Connections.** Do not use bolted connections, except
214 for field splices, or as detailed in the contract documents. Use high-
215 strength bolts, nuts, and washers of type and dimensions specified at
216 locations indicated in the contract documents.
217

218 Furnish and use bolts with hexagonal heads and nuts. Use
219 bolts that are long enough to extend entirely through nut, but not by
220 more than 1/2 thickness of nut. Use two nuts for bolts in tension.
221

222 Unfinished bolts in shear shall not have more than one thread
223 within grip. Diameter of bolt shall conform to Article 6.13.2.5- Size of
224 Bolts, and diameter of bolt holes shall conform to Article 6.13.2.4 -
225 Holes, of the AASHTO *LRFD Bridge Design Specifications*.
226

227 Threads of turned bolts shall be entirely outside grip. Sub-
228 punch and ream holes for all turned bolt connections to 1/32-inch
229 oversize. Finish bolts to provide a driving fit. Furnish acceptable nut
230 locks or flat washers, 1/4-inch-thick, as specified in the contract
231 documents.
232

233 Furnish bolted connections using high-strength steel bolts
234 conforming to *Specifications for Structural Joints Using ASTM A 325*
235 *or A 490 Bolts* and the following provisions:
236

237 **(a)** Clean contact surfaces of high-strength bolted
238 connections of rust, mill scale, dirt, grease, paint, lacquer, and
239 other material foreign to steel, before assembly.
240

241 **(b)** Furnish and install bolts conforming to ASTM A 325 with
242 hardened washer under nut or bolt head, whichever is the
243 element turned in tightening. At the Contractor's option and at
244 no increase in contract price or contract time, the Engineer will
245 allow utilization of hardened washer under both nut and bolt
246 head.
247

248 (c) Furnish and install direct tension indicator washers
249 acceptable to the Engineer for tightening of bolts. Submit
250 procedures for installation and inspection of direct tension
251 indicator washers, as recommended by manufacturer, to the
252 Engineer. Include in submitted procedures the proposed
253 method for checking and retightening bolts that may have
254 worked loose after subsequent bolt tightening.
255

256 Tightening of ASTM A 325 or ASTM A 490 bolts by
257 turn-of-nut method or calibrated wrench method will not be
258 allowed.
259

260 Tightening of ASTM A 449 studs or anchor bolts by
261 turn-of-nut method or calibrated wrench method will be
262 permitted if the Engineer accepts the Contractor's proposed
263 method.
264

265 (d) Locate nuts wherever practicable on side of member
266 that will not be visible from traveled way.
267

268 (F) **Painting.**
269

270 (1) **General.** Painting of metal structures shall include preparation
271 of metal surfaces, application, protection and drying of paint coating,
272 supplying tools, tackle, scaffolding, labor, and materials necessary for
273 entire work.
274

275 Before painting, round sharp edges of structural steel to
276 maximum radius of 1/16 inch.
277

278 Treat finished surfaces of bearing plates and rollers as
279 indicated in the contract documents.
280

281 Paint steel with one shop or prime coat and not less than two
282 field coats. Provide minimum dry film thickness of 1.5 mils for shop
283 coat and 1.0 mil for field coat. Paint prime coat and first field coat with
284 red primer paint. Paint second field coat with finish coat indicated in
285 the contract documents and acceptable to the Engineer. Provide
286 coats sufficiently different in color to permit detection of incomplete
287 application.
288

289 (2) **Weather Conditions.** Paint only thoroughly dry surfaces and
290 only during periods of favorable weather. Painting will not be allowed
291 when atmospheric temperature is below 40 degrees F or when
292 relative humidity is above 85 percent. Remove and replace fresh
293 paint damaged by bad weather and moisture.
294
295

295 **(3) Preparation of Zinc-Coated Surfaces.** When painting
296 zinc-coated surfaces, defer painting to allow surfaces to weather to a
297 dark, nearly black color. Before painting, treat zinc-coated surfaces
298 with solution that contains two ounces each of copper chloride, copper
299 nitrate, and sal ammoniac dissolved in one gallon of soft water in
300 earthen or glass container. Then add two ounces of commercial
301 muriatic acid and mix thoroughly. Apply solution to zinc-coated
302 surface with wide, flat brush. Upon drying, the coated surfaces will
303 appear gray. A commercial product that produces same results on
304 zinc-coated surfaces, or alternative treatment that conforms to
305 Pretreatment Specifications No. 3 - Basic Zinc Chromate Vinyl Butyral
306 Washcoat, of the *Steel Structures Painting Council Handbook* may be
307 used.

308
309 **(4) Cleaning of Surfaces.** Thoroughly remove rust, loose mill
310 scale, dirt, oil or grease, other foreign substances, and anti-weld
311 spatter coating from surface of metal before painting. If rust appears
312 on cleaned surface before application of paint, reclean surface before
313 painting.

314
315 Before painting, choose one of following methods of cleaning
316 and obtain the Engineer's acceptance:

317
318 **(a) Hand Cleaning.** Use wire brushes, scraping tools, or
319 sandpaper. At the Engineer's discretion, some power-driven
320 will be acceptable, at the Engineer's discretion. Pneumatic
321 chipping hammers will not be allowed. Remove oil and grease
322 with acceptable solvent.

323
324 **(b) Blast Cleaning.** For blast cleaning, use abrasives
325 manufactured from clean, dry sand or material grit of grading
326 acceptable to the Engineer. The Engineer will not allow use of
327 unwashed beach sand.

328
329 Use acceptable dry-blast cleaning apparatus, in
330 accordance with Specification No. SP5-52T - Blast Cleaning to
331 White Metal, of the *Steel Structures Painting Council*
332 *Handbook*. White metal is defined as surface with uniform
333 gray-white metallic color, slightly roughened to form suitable
334 anchor pattern for painting.

335
336 **(5) Application of Paint.** Apply paint by brush, spray, roller, or
337 combination of these methods.

338
339 When using brushes, apply paint to produce smooth, uniform
340 coating, brushing out runs or sags. The Engineer will consider
341 numerous brush marks to be improper paint application.

342

343 Use type of roller that does not leave stippled texture in paint
344 film.

345
346 When spray methods are proposed for use, spray operator
347 shall have minimum three years of experience and shall submit
348 certificate of experience. Required qualifications for spray operator
349 include ability to correctly adjust equipment, application, and
350 technique; and perform equipment maintenance. Protect adjoining
351 areas from overspray or paint mist. Runs, sags, thin areas in paint
352 coat, or skips and holidays are evidence of unsatisfactory work, and
353 will be cause for the Engineer to require brushwork for remainder of
354 painting.

355
356 Use traps or separators sized adequately to remove oil and
357 water from compressed air. Drain traps or separators periodically
358 during operations. Air from spray gun impinging against surface shall
359 show no water or oil.

360
361 Use brushes to paint areas inaccessible to spray gun. Brush to
362 work paint into cracks, crevices, and blind spots. If surface is
363 unreachable by brush, use daubers or sheepskins.

364
365 Thoroughly mix paint ingredients in container before use, and
366 agitate often during application to keep pigment in suspension.

367
368 If it is necessary to thin paint in cool weather to make paint
369 spread more freely, heat paint container in hot water. Do not add or
370 remove liquid from paint.

371
372 Cure or dry each coat of paint in accordance with
373 manufacturer's recommendations before applying successive coats.

374
375 Remove painting that fails to conform to requirements.
376 Thoroughly clean and repaint metal.

377
378 **(6) Prime Coat.** Ship structural steel with one coat of shop-
379 applied prime coat for the Engineer's inspection and acceptance.
380 After acceptance, apply one prime coat and one finish coat of required
381 paint at the Contactor's storage yard before delivery to work site.

382
383 Apply shop-coat type of paint to surfaces of metal that will be in
384 contact after field erection, provided paint does not interfere with
385 assembly.

386
387 Before erection, apply all required coats of paint or three shop
388 coats of specified primer to surfaces of metal that are not presently in
389 contact, but that will be inaccessible after assembly.

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391 Surfaces of metal assembled in the shop that are in contact
392 shall not be painted. Do not paint structural steel until all shop welding
393 has been completed.

394
395 Field-welded surfaces within two inches from point of weld shall
396 not be painted.

397
398 After field welding is complete, clean unpainted surfaces to
399 bright metal and coat with acceptable shop primer and two finish coats
400 of paint.

401
402 Do not paint surfaces to be in contact with concrete.

403
404 If unpainted surfaces will be exposed to weather for an
405 extended period of time before erection, protect surface with coat of
406 lacquer or similar coating acceptable to the Engineer. Remove this
407 coating before erection.

408
409 Give milled or finished surfaces of iron and steel castings one
410 coat of paint.

411
412 Coat machine-finished surfaces, except abutting joints and
413 base plates, with acceptable hot mixture of white primer and tallow or
414 other acceptable commercial product. The Engineer will inspect
415 coated items before removal from shop.

416
417 Paint erection marks for field identification of members, and
418 weight marks on surfaces previously painted with shop coat. Do not
419 load material for shipment until paint is thoroughly dry. Do not remove
420 material until at least 24 hours after applying paint.

421
422 **(7) Field Painting.** Upon completion of erection, clean surfaces in
423 accordance with Subsection 501.03(F)(4) - Cleaning of Surfaces.

424
425 Clean surfaces not coated with shop paint or those with
426 required coating worn off or defective, and cover thoroughly with one
427 coat of required primer.

428
429 Do not paint surfaces that are to be in contact with concrete.
430 Paint surfaces that will be inaccessible after erection, with required
431 field coats. Apply required field coats after retouched prime coat has
432 thoroughly dried and required field cleaning has been completed. If
433 small cracks and cavities have not been sealed watertight, fill with
434 pasty mixture of red primer and linseed oil. Apply second coat.

435
436 To secure maximum coating on edges of plates or shapes and
437 other parts subject to special wear and attack, stripe edges first with
438 longitudinal motion and bolt heads with rotary motion of brush. Follow

439 immediately with general painting of entire surface, including edges
440 and bolt heads.

441

442 If the Engineer orders precautionary or corrective measures to
443 prevent dust, dirt, and other foreign matter from touching freshly
444 painted surfaces, or to prepare surfaces for painting, provide these
445 measures at no increase in contract price or contract time.

446

447 Steelwork in structures that have concrete floors shall not be
448 painted with first field coat until completion of concrete floor, including
449 formwork removal. In other cases, defer application of second field
450 coat until completion of placing and finishing adjoining concrete work,
451 not including concrete floors. Reclean and repaint surfaces damaged
452 by concreting operations.

453

454 Protect pedestrian, vehicular, and other traffic from injuries or
455 damage from spatters, splashes, or smirches of paint or paint
456 materials.

457

458 Use 2-inch-high letters and numerals to stencil structure
459 number, month, and year of painting at locations indicated in the
460 contract documents or designated by the Engineer. Choose paint
461 color that will contrast distinctly with background.

462

463

(G) Zinc Coating.

464

465 **(1) Zinc Coating.** Zinc coat after fabrication using hot-dip
466 process. Coat largest practicable area in accordance with Subsection
467 712.10 - Zinc Coating. Fabrication shall include shearing, punching,
468 forming, bending, welding, and riveting. If sections need to be
469 straightened after zinc coating, straighten without damaging spelter
470 coating.

471

472 **(2) Repairing Damaged Zinc-Coated Surfaces.** Repair zinc
473 coating that has chipped off or been damaged in handling,
474 transporting or welding. Thoroughly clean damaged zinc-coated
475 surfaces by wire brushing damaged area. Remove sags, welds, and
476 loose and cracked spelter coating. Paint cleaned area after
477 completing any of the following procedures:

478

479 **(a)** Apply coating material conforming to Federal
480 Specification O-G-93, stick form, in accordance with method
481 conforming to Annex A1 of ASTM A 780. Heat coated surface
482 with torch at sufficient temperature to melt repair material
483 without damage to zinc coating.

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485 (b) Apply two coats of zinc-oxide, zinc-dust paint
486 conforming to Federal Specification MIL-E-15145B. Mix paint
487 properly in suitable vehicle in ratio of one part zinc-oxide to four
488 parts zinc-dust by weight.

489
490 (c) Apply two coats of premixed formulation containing not
491 less than 95 percent zinc in dried film meeting the
492 requirements of Federal Specification MIL-P-226915A.

493
494 (d) Apply two coats of formulation with high zinc-dust
495 content meeting the requirements of Federal Specification MIL-
496 P-21035.

497
498 (H) Concrete Floors. Do not place concrete floors on steel spans until
499 centering under bridge has been released and spans have swung free onto
500 their supports. Place concrete in floor slab continuously between joints, or as
501 ordered by the Engineer. In case of emergency, provide construction joints
502 as ordered by the Engineer.

503
504 (I) Removal of Falsework. Upon completion of erection process and
505 before final acceptance of structure by the Engineer, remove falsework,
506 excavated, or unnecessary materials, rubbish, and temporary buildings.
507 After removal of falsework, check for proper camber in steel beams and
508 girders. Measure camber at top of web and make corrections to shots to
509 adjust flange thickness.

510
511 501.04 Measurement. Structural steel will be paid on a lump sum basis.
512 Measurement for payment will not apply.

513
514 501.05 Payment. The Engineer will pay for the accepted structural steel on a
515 contract lump sum basis. Payment will be full compensation for the work prescribed
516 in this section and the contract documents.

517
518 The Engineer will pay for the following pay item when included in the proposal
519 schedule:

520	521 Pay Item	522	523 Pay Unit
524	525 Structural Steel - _____	526	527 Lump Sum

528 The Engineer will pay for bronze and stainless steel bearing plates in
529 accordance with and under Section 506 - Bearing and Expansion Plates.

530 The Engineer will pay for falsework lighting in accordance with Section 633 -
531 Falsework Lighting and under Section 503 - Concrete Structures.

532