

Heavy Movable Structures, Inc.

SEVENTH BIENNIAL SYMPOSIUM

November 4 - 6, 1998

**Grosvenor Resort
Walt Disney World Village
Lake Buena Vista, Florida**

“Inspection/Testing of Structural Steel and Machinery Components”

by

Adil Khan, Law Engineering & Environmental Services

**INSPECTION AND TESTING OF STRUCTURAL STEEL
AND
MACHINERY COMPONENTS**

PRESENTED BY

**ADIL H. KHAN, P.E.
LAW ENGINEERING AND ENVIRONMENTAL
SERVICES, INC.**

**HEAVY MOVABLE STRUCTURES
7TH BIENNIAL SYMPOSIUM**

1 ☐ *Inspection/Testing of Structural Steel and Machinery Components*

Adil H. Khan, P.E.
Materials Consultant
Law Engineering and Environmental Services
Jacksonville, Florida

2 ☐ *Presentation Summary*

- Discussion of Services Provided.
- Discussion of Inspection /Testing we perform at Fabrication /Manufacturing Facilities and Project Sites.
- Suggestions on Improvements.
- Benefits of Change.

3 ☐ *Scope of Services*

- Inspection and Testing of Fabricated Steel Bridges.
- Inspection of Overhead Sign Structures.
- Failure Analysis of Structural Steel and Bridge Components.
- Inspection and Testing of Concrete and other Construction Materials.

4 ☐ *Scope of Services, Continued*

- Inspection and Testing of Machinery Items such as Trunnions, Trunnion Collars, Open Gearing, Hopkins Frames, Tread Plates, Rack Frames (Rolling Lifts).
- Shop Inspection of Speed Reducers.
- Shop Inspection of Hydraulic Power Units, Hydraulic Cylinders, Span Locks.

5 ☐ *Service Locations*

- Steel Fabrication Shops.
- Manufacturing Plants for Speed Reducers, Span Locks, Hydraulic Power Units, Hydraulic Cylinders.
- Specialty Testing Laboratories.
- On-site Testing.

6 ☐ *Structural Steel Fabrication Inspections*

- Conduct pre-fabrication conferences.
- Shop inspections.
- Inspect quality and traceability of raw materials.

- Monitor fabrication processes for conformance with specified methods and practices.

7 ☐ *Structural Steel Fabrication Inspections, Continued*

- Welder certifications.
- Monitor and confirm all shop NDT.
- Dimensional verification - spot checks only.
- Confirm fabrication follows approved drawings.
- Follow up change orders, repairs, NCRs, RFIs, etc.

8 ☐ *Structural Steel Fabrication Inspections, Continued*

- Inspect painting of structural steel and verify preparation techniques. Inspect zinc coatings and their application process.
- Provide helpful advice, based on experience, in order to minimize fabrication errors and delays.

9 ☐ *Inspection of Speed Reducers*

- Verify shop testing performed on new and refurbished speed reducers is in accordance with project TSPs.
- Testing involves no-load spin tests and tests performed at 50-300 percent of full load motor torque. Loads and time periods are decided by design consultant.

10 ☐ *Inspection of Speed Reducers, Continued*

- Post testing inspection to determine condition of gearing components. Verify contact patterns for all gearing.
- Verify condition of gear teeth and observe for signs of distress in the form of pitting, polishing, scuffing, etc.
- Review material certifications and heat treatment documentation.

11 ☐ *Inspection of Hydraulic Power Units*

- Verify testing on hydraulic power units is performed in accordance with project TSPs.
- Testing primarily involves high pressure static testing for integrity of power units.
- Changes implemented by designer and manufacturer have provided refined testing methods on several recent projects.
- Verification of material certifications.

12 ☐ *Inspection of Hydraulic Power Units, Continued*

- Testing is designed to verify functionality and usability of power units under extreme conditions.
- Testing requirements in existence are vague and require modifications.
- Consider incorporation of some dynamic testing prior to acceptance of power units.

13 ☐ *Inspection of Hydraulic Cylinders*

- Pressure testing of newly fabricated hydraulic cylinders up to 6000 psi.
- Pressure testing of refurbished hydraulic cylinders up to 4500 psi.
- Existent testing requirements are limited, and do not provide a comprehensive inspection for quality of the end product.

14 ☐ *Inspection of Hydraulic Cylinders, Continued*

- Testing is designed to verify functionality and usability of cylinders under extreme conditions.
- Pre-assembly inspection of cylinder components is not performed, but is essential prior to cylinder testing.
- Verification of material certifications.

15 ☐ *Technical Special Provisions*

- Specifications for structural steel inspection have been updated consistently and appear to cover most aspects of shop inspection for quality assurance.
- Specifications for bridge machinery should be modified and updated to reflect newer technologies especially in hydraulic systems.

16 ☐ *Technical Special Provisions, Continued*

- Inspection agency should review TSPs prior to project letting (in design stage).
- Pre-manufacturing conferences must be made a part of the contract, so as to define the purpose of shop inspection and clarify testing requirements.
- Most manufacturers are not cognizant of all aspects of testing and are ill-prepared.

17 ☐ *Contractual Compromises*

- Scheduling problems are a norm and costly to the project.
- Delivery dates are often compromised, especially when materials are not in conformance with specifications.
- Compromises are often necessary due to time restraints.

18 ☐ *Conclusions*

- Pre-fabrication conferences for structural steel are normal and benefit all.
- Pre-manufacturing conferences for movable machinery should serve the same purpose, and should be implemented.
- Limited inspections and Audit of Shops should be performed at various stages of the project.

19 ☐ *Conclusions, Continued*

- Timely notification for inspection and testing is necessary.
- Shops must provide details on test methods as part of their submittals for approval.
- Documentation on equipment calibration should be a part of certifications submittal.

20 ☐ *Recommendations*

- Rewrite 460/465 - bring up to date with current practice.
 - Punching/Drilling/Reaming
 - Die Stamping
 - Laydown/Assembly
 - Bolting (short grip, re-use, etc.)

21 ☐ *Recommendations, Continued*

- Consider sealing boxed-in or inaccessible areas to prevent corrosion.
- FDOT and Designers should work with Resident and Contractor to ensure quick responses to RFIs, NCRs. Keep inspection agency informed.

22 ☐ *Recommendations, Continued*

- Details on redundant, non-redundant main, secondary members should be provided.
- Shop assembly tolerances should be specified for squareness and alignment.
- Detail appropriate welding codes D1.5, D1.1, D1.5 for Bridges, D1.1 for Handrails or D1.1 for Platforms, etc.

23 ☐ *Recommendations, Continued*

- Specifications used in fabrication and manufacturing of equipment should be updated on a regular basis. Allow industry input.
- For testing specifications, differentiate between new systems and refurbished systems.

24 ☐ *Recommendations, Continued*

- Specifications for inspection of speed reducer drives should be updated and testing of components prior to assembly should be included to verify integrity.
- Specifications for shop testing of speed reducers should be reviewed and updated. Testing procedures, methodology and equipment should be consistent for all units.

25 ☐ *Recommendations, Continued*

- Specifications for the testing of hydraulic power unit systems should be revised to

incorporate testing of computer controlled systems, in addition to pressure testing.

- Specifications for HPUs should also include inspection of fabricated components, such as tanks, welded pipes, etc.

26 ☐ *Recommendations, Continued*

- Specifications for testing and inspection of hydraulic cylinders should be revised to include inspection of cylinder components.
- Materials of manufacture and welding of parts should be closely monitored during fabrication.
- Metal coated parts such as piston rods should be inspected prior to assembly.

27 ☐ *Recommendations, Continued*

- Pre-manufacturing conference, to include shop audits should be held with machinery manufacturers to define testing and inspection requirements.
- Refurbished equipment must be inspected during all stages of manufacture to prevent surprises during testing.

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