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From: Commander, Naval Facilities Engineering Command, NAVFAC Criteria Office (Code 15C)
To: Distribution

Subj: INTERIM TECHNICAL GUIDANCE - WIRE ROPE AND STRAND

Ref: (a) PHONCON btwn LANTNAVFACENGCOM (Code 402) George Malamos/NAVFAC Criteria Office (15C) David Curfman of 9 Feb 95

Encl: (1) Factors of Safety - Wire Rope and Wire Strand used in Civil Engineering Applications

1. Purpose: The purpose of this guidance is to define the minimum factor of safety against breaking for wire strand used to guy overhead steam line supports. This guidance should be retained until it is incorporated into the criteria noted in paragraph 4.

2. Background: Wire strand and wire rope have many uses and consequently many performance requirements. Safety factors vary from 2 to 15 depending on the use, but are more commonly between 2 and 6. These factors account for vibration, shock, abuse, corrosion, manufacturing and maintenance tolerances, acceleration, misalignment, deflection, and minor stress concentration. For reference, enclosure (1) is provided. It is a compilation of recommended Factors of Safety for wire rope and strand.

The material specification typically used for structural guys is ASTM A475, "Standard Specification for Zinc-Coated Steel Wire Strand." However, engineers also use ASTM A586, "Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand," and ASTM A603, "Standard Specification for Zinc-Coated Steel Structural Wire Rope." For strand, ASTM A475 denotes the requirements for wire strand in diameters from 1/8 inch to 1-1/4 inch. Five grades of strand are available with tensile strengths ranging from 35,000 psi to 150,000 psi. The high strength grade is around 100,000 psi and the extra-high strength grade is around 140,000 psi. ASTM A586 denotes the requirements for wire strand in diameters from 1/2 inch to 4 inches. Tensile strengths range from 200,000 psi to 220,000 psi. ASTM A603 for wire rope is similar to ASTM A586 for strand except the tensile strengths are about 25% lower.

The guy wires used to anchor overhead steam lines, that is, not running lines, mooring lines, or life safety lines, are structural members.

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3. Criteria: For wire strand used to guy overhead steam line supports in occupied areas, use a minimum factor of safety against breaking of 3.0. In unoccupied areas, a factor of safety of 2.0 is acceptable. The wire strand should be minimum 3/8 inch diameter conforming to ASTM A475, high grade. Since the wire does not protect human life, there is no need for a safety factor of 5 (USACE) or 6 (OSHA). However, in the case of overhead steam lines, a failure may cause personal injury to the nearby public and cripple lifeline steam supply to the base. Hence, the prescribed safety factors.

4. Action:

a. NAVFAC Headquarters, Engineering Field Divisions (EFDs), Engineering Field Activities (EFAs), Officers in Charge of Construction (OICCs), Public Works Centers (PWCs), Public Works Departments (PWDs) shall plan, design, and construct overhead steam lines in compliance with the criteria stated herein.

b. NAVFAC Criteria Office will coordinate revisions of the following criteria to incorporate the interim technical guidance stated herein:

Military Handbook 1002/3, "Steel Structures"
NFGS -2695, "Exterior Aboveground Steam Distribution System"

5. Points of Contact: For clarification or additional information related to this subject, please contact the NAVFAC Criteria Office, Code 15C. The NAVFAC Criteria Office Point of Contact is Mr. David Curfman, P. E., DSN 262-4203/ 804-322-4203, fax 804-322-4416, Internet CURFMAN@efdlant.navy.mil.

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FACTORS OF SAFETY -
WIRE ROPE AND WIRE STRAND
USED IN CIVIL ENGINEERING APPLICATIONS

Element	Factor of Safety ¹	Reference
1. Prestretched and non-prestretched wire strand used in unoccupied areas (ASTM A586 and ASTM A475)	2 (no overstress for wind)	NAVFAC, MIL-HDBK 1002/3, "Steel Structures"
2. Prestretched and non-prestretched wire rope used in unoccupied areas (ASTM A603)	2 (no overstress for wind)	NAVFAC, MIL-HDBK 1002/3, "Steel Structures"
3. Structural strand used for tower guys (ASTM A475, Extra High-strength grade)	2.0 for heights under 700 ft and 2.5 for heights above 1200 ft (interpolate between with no overstress for wind)	EIA/TIA-222-E Note: Bob Prince, Chief Engineer's Office, recommends using 3/8" min.
4. Structural strand used to guy supports for overhead power lines (ASTM A475, High strength or Extra-High strength grade)	3.0 for Grade D 2.7 for Grade B 2.4 for Grade C	ANSI C2, "National Electrical Safety Code" and NFGS-16370
5. Steel cables designed according to AISI, "Steel Cables for Buildings"	5	USACE, TM 5-809-2, "Structural Design Criteria for Buildings"
6. Load-carrying steel cables in buildings (ASTM A586 and A603)	2.2 (DL+P/S) 2.2 (DL+LL+P/S) 2.0 (TL + EQL) 2.0 (TL + WL)	AISI, "Steel Cable Manual" [DL=dead load, LL= live load, TL=total load, WL= wind load, EQL= earthquake load, P/S=prestress]
7. Scaffolding	6	OSHA, 1910.28 (a)(22)
8. Elements on large cranes and derricks	4-6	NAVFAC, DM 38.1, "Weight Handling Equipment"
9. Hoists and winches	5	NAVFAC, DM 38.1, "Weight Handling Equipment"
10. Shipboard rigging and mooring lines	5	NAVSEA, S9086-UU-STM-010, "Wire and Fiber Rope"

¹Factor of Safety based on the breaking strength, i.e the ultimate strength for wire rope and strand.