

FROM: AFCESA/CES
139 Barnes Drive, Suite 1
Tyndall AFB FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 97-4: Expedient Trim Pad Anchoring System**

1. Purpose. This ETL provides nonmandatory guidance for construction of an anchoring system for an expedient trim pad. The procedure in paragraph 4 may be used when construction of a permanent trim pad is not practical.

2. Application: All Air Force organizations with pavement construction responsibility.

2.1. Authority: U.S. Army DG 1110-3-204, *Design Guide for Army and Air Force Airfields, Pavements, Railroads, Storm Drainage, and Earthwork* (see para. 2.2).

2.2. Effective Date: Immediately. Remains in effect until publication of AFJMAN 32-1033, *Design Guide for Airfields, Pavements, Railroads and Earthwork*; or until expiration.

2.3. Expiration: Five years from date of issue.

2.4. Ultimate Recipients:

- Air Force Base Civil Engineers, Red Horse Squadrons, and other units responsible for design, construction, maintenance, and repair of trim pads.
- Corps of Engineers and Navy offices responsible for Air Force design and construction.

3. Referenced Publications:

3.1. Wright Laboratories Report, "Expedient Trim Pad Anchor Test," 4 April 1996.

Note: This report was prepared for the 823rd Red Horse Squadron to determine load carrying capacity of a group of 12 earth anchors used in the Mobile Aircraft Arresting System (MAAS). The tests, conducted at Tyndall Air Force Base, concluded that a 12-stake anchor group constructed in similar soil conditions should support a maximum load of 18,144 kilograms (40,000 pounds). Guidance in this ETL was extracted from this report.

3.2. Technical Order 35E8-2-10-1, *Operation and Maintenance Instructions, Arresting Systems, Aircraft, Mobile, Model No. AM32A-96*.

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4. Procedure:

4.1. Step 1. Select tentative location for Trim Pad with 12-stake anchor group at both cable ends. See Figure 1 for typical location. See 12-stake anchor group schematic at Figure 2.

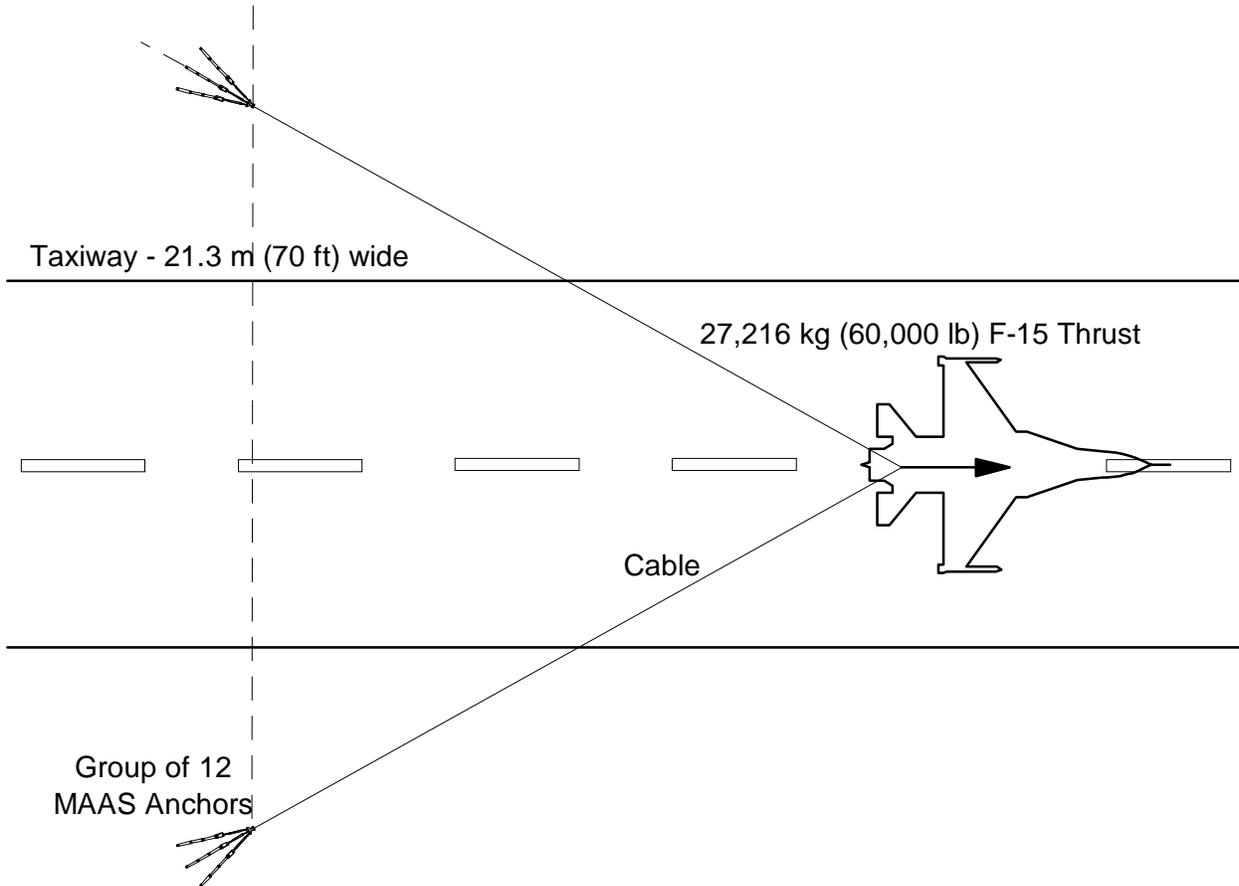


Figure 1. Expedient Trim Pad Schematic.

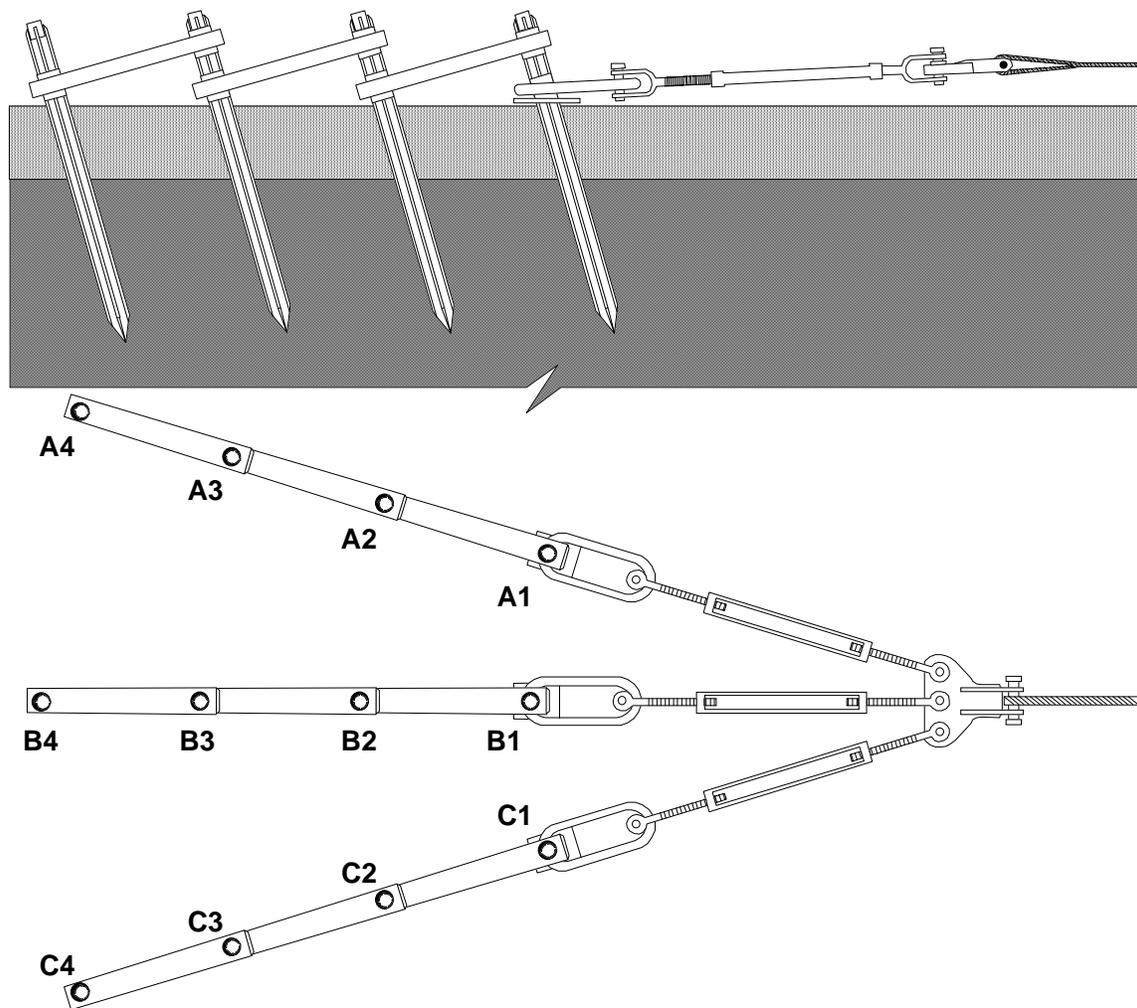


Figure 2. 12-Stake Anchor Group Schematic.

4.2. Step 2. Perform three Dynamic Cone Penetration tests, spaced 0.6-0.9 meters (2-3 feet) apart, at each anchoring location to determine the California Bearing Ratio (CBR) profile of the soil. Compare the CBR profiles to the profiles developed for the test location (Figure 3). If the average CBR profile is about the same or consistently higher, then the pullout capacity of the anchor group should be 18,144 kilograms or higher. If a lower CBR profile is measured, the anchor group capacity will be less than 18,144 kilograms. In this case, either use the DCP to find firmer soil, or increase the number of stakes in each anchor group. See a 16-stake anchor group schematic at Figure 4.

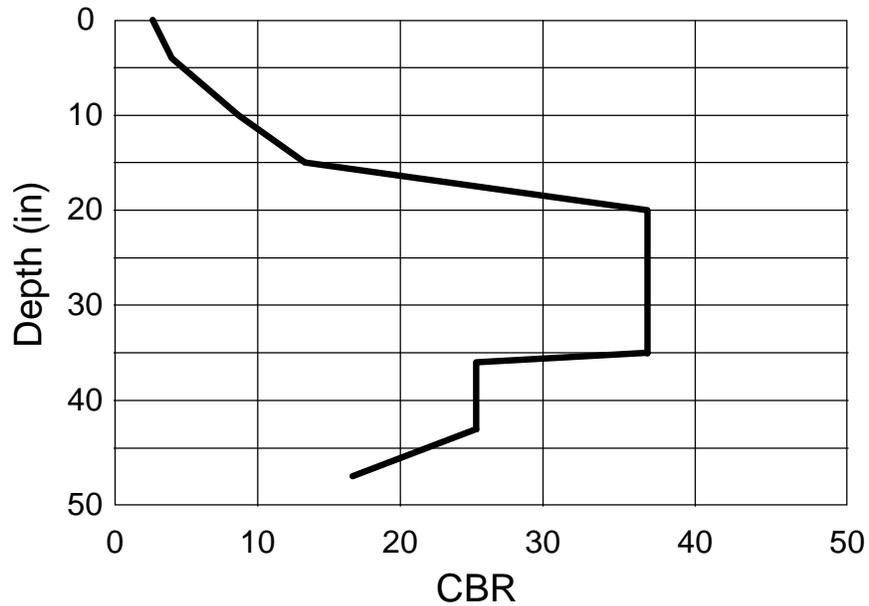


Figure 3. CBR Profile for Test Locations.

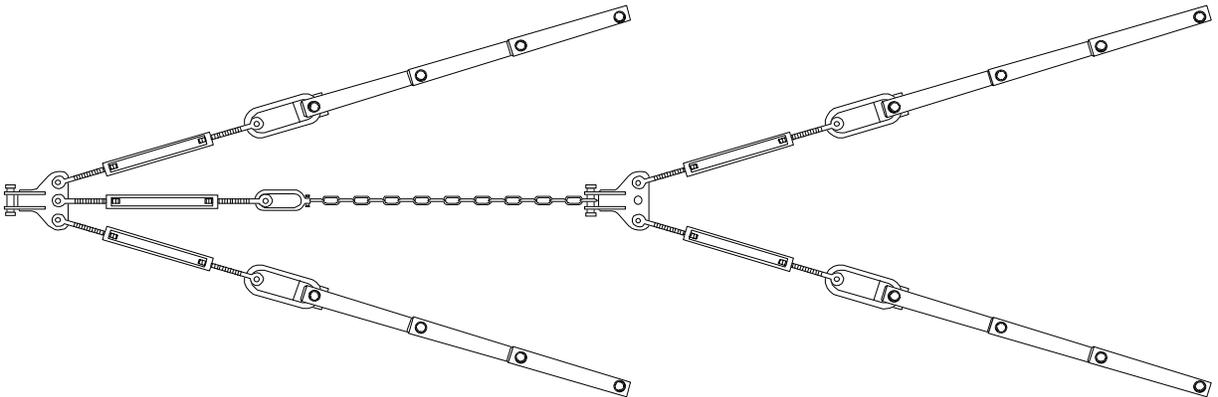


Figure 4. 16-Stake Anchor Layout.

4.3. Step 3. Line up the center line of stakes with the anticipated direction of cable pull when the aircraft is secured to the cable.

Note: Cable length and distance between anchor groups have an effect on anchor load (see Figure 5). For best results, minimize distance between anchor groups and maximize cable length. Refer to the following table for examples. Assume an F-15 with a 27,216 kilogram (60,000) pound thrust (horizontal component of thrust in the cable to the anchor group: 13,608 kilograms [30,000 pounds]).

Distance Between Anchor Groups meters (feet)	Cable Length meters (feet)	Multiplier (× horizontal component of thrust)	Total Thrust per Anchor Group kilograms (pounds)
18.3 (60)	91.4 (300)	1.01	13,744 (30,300)
30.5 (100)	91.4 (300)	1.06	14,425 (31,800)
18.3 (60)	45.7 (150)	1.09	14,833 (32,700)
30.5 (100)	45.7 (150)	1.35	18,371 (40,500)

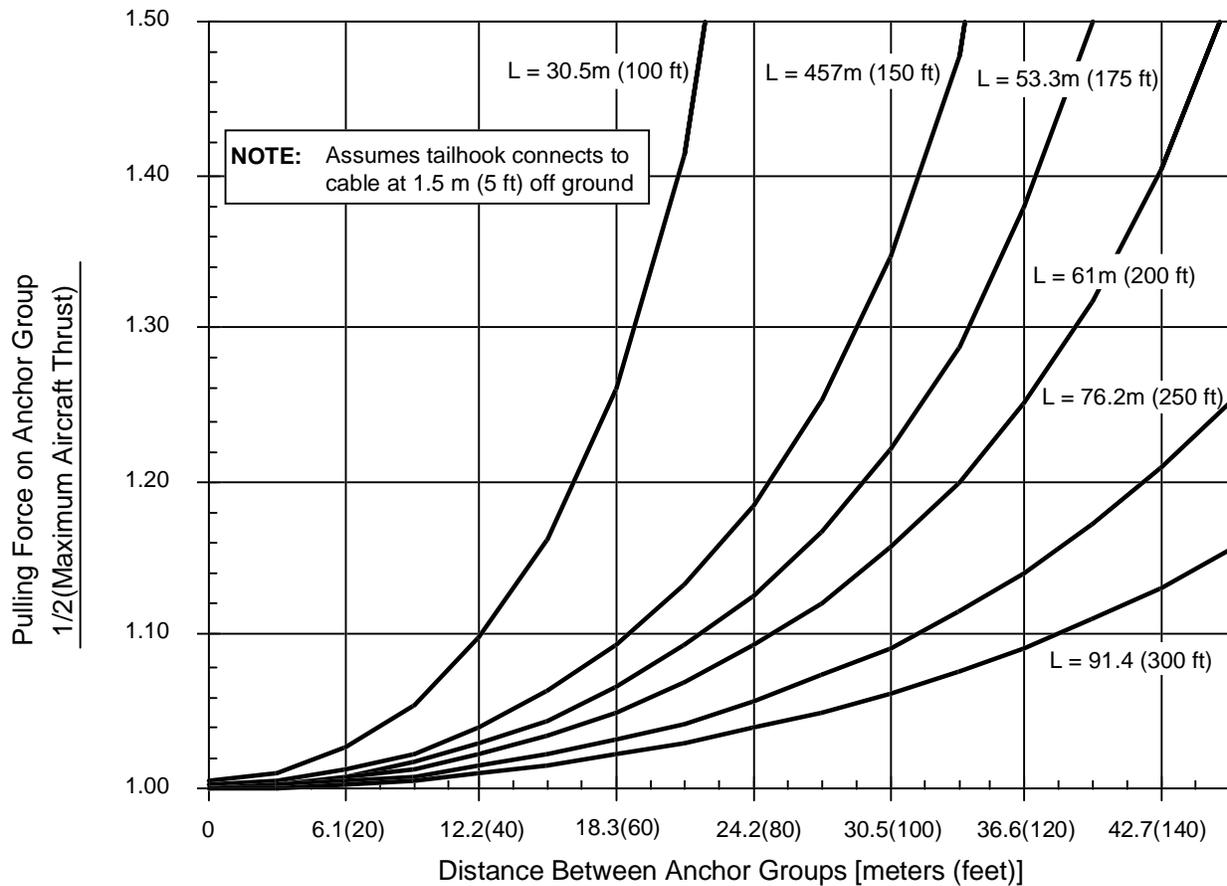


Figure 5. Effect of Cable Length on Required Anchor Capacity.

Caution: Observe load limits of the shackle, clevis, or other fitting used to connect the cable to the triple turnbuckle fitting. A fitting marked "WLL 10 TON" has a working load limit of 9,072 kilograms (20,000 pounds): not enough for the expected 13,608+ kilogram load from the cable to the anchor group.

4.4. Step 4. Follow standard MAAS procedures for soil installation of "KM" stake lines in T.O. 35E8-2-10-1, paragraph 3-1.5.

4.5. Step 5. With all stakes in place, adjust the turnbuckles so that the triple turnbuckle fitting lines up with the center row of stakes and the cable position expected at maximum thrust. If possible, apply light tension to the cable and make any additional adjustments to distribute the pulling load as evenly as possible among the three anchor stake lines.

4.6. Step 6. Install a string line (Figure 6) across the front of the anchor group. Use the string line as a reference to monitor movements of the front anchor stakes over the duration of the mission. The string need not remain in place during run-up operations, but reference points should be marked on the stakes so that consistent measurements can be made. Arrange the reference stakes and string line so that the movement of the front stakes at the ground surface can be easily measured.

4.7. Step 7. Monitor the performance of each anchor group for at least the first five run-up operations. Ensure personnel stay clear of the cable and anchors during engine run-up. Between initial operations, check lateral movement of the front anchor set at the ground surface by measuring off the string line. Use the following criteria on pavement front anchor lateral displacement as a rough guide to judge anchor group performance:

- Less than 1 inch Adequate (condition GREEN)
- 1 to 2 inches Degraded (condition AMBER)
- Greater than 2 inches Unsatisfactory (condition RED)

4.8. Step 8. After initial operations, check each anchor group after approximately every 20 operations. Inspect overall anchor stake movements and use the string line as a reference to measure front stake displacement.

4.9. Step 9. If more than 12 anchor stakes are needed for each anchor group, do not add more to the rear of each 4-stake line. (The front anchor in a longer line of stakes will not be able to transmit the cumulative anchoring force to the turnbuckle without failing in bending.) Use an alternate arrangement of 4-anchor lines, such as shown in Figure 4 (copied from section 8, figure 8-6 of the MAAS training materials).

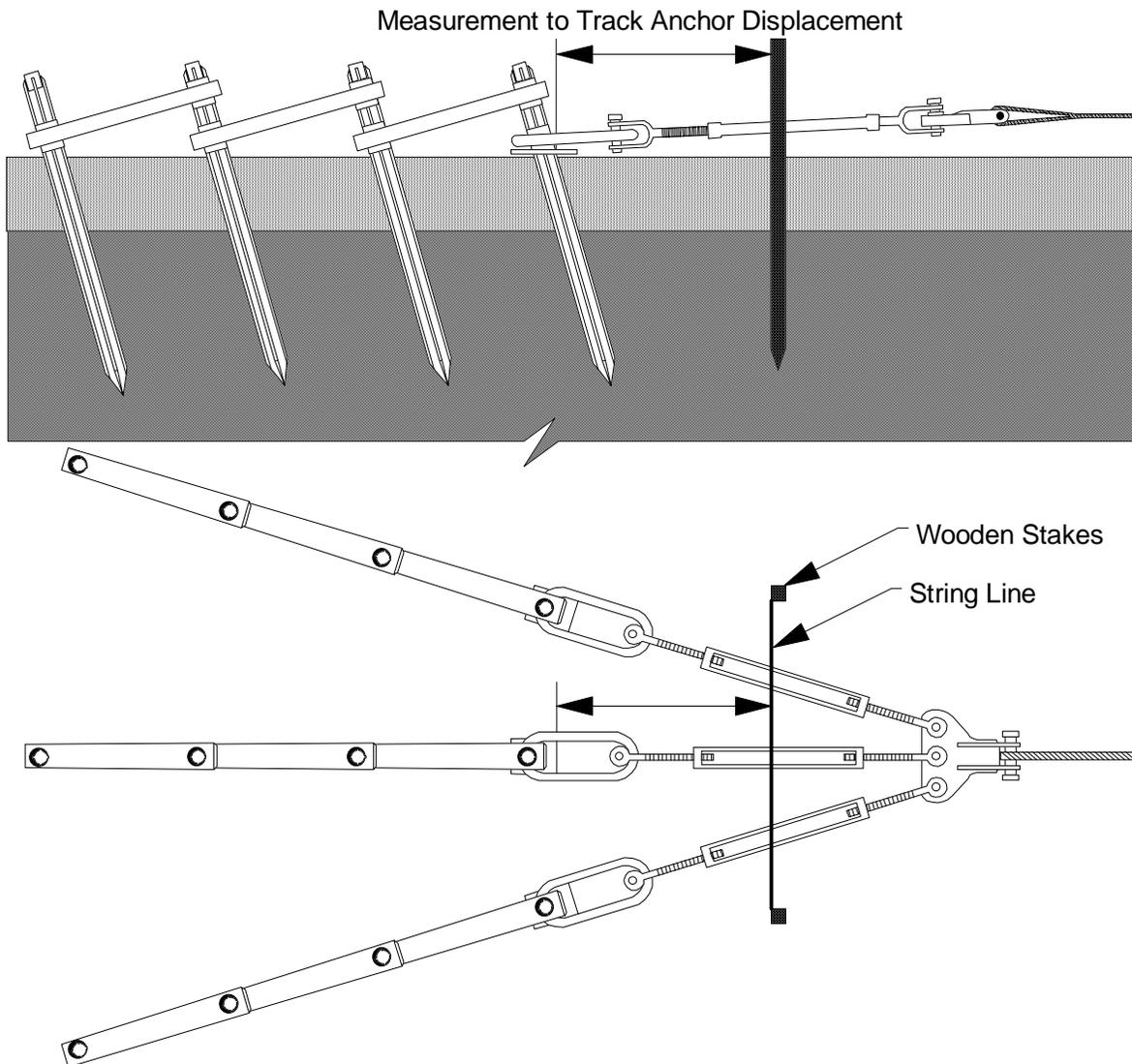


Figure 6. Reference Line for Monitoring Anchors.

5. Point of Contact: Mr. Jim Greene, HQ AFCEA/CESC, DSN 523-6334, commercial (904) 283-6334 or INTERNET greenej@afcesa.af.mil.

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