U.S. Department
of Transportation
Federal Highway Administration

1200 New Jersey Avenue, SE
Washington, D.C. 20590

April 16, 2010

In Reply Refer To:
HSSD/B-206

Paul Fossier, P.E.
Assistant Bridge Design Administrator
Bridge and Structural Design Section, Rm. 608J
Louisiana Department of Transportation and Development
Baton Rouge, LA 70804-9245

Dear Mr. Fossier:

This letter is in response to your request for Federal Highway Administration (FHWA) acceptance of a roadside safety system for use on the National Highway System (NHS).

Name of system: Louisiana 12-ft. Pinned F-Shape Portable Concrete Barrier
Type of system: F-Shape Reinforced Concrete Barrier
Test Level: NCHRP Report 350 Test Level 3 (TL-3)
Testing conducted by: Texas Transportation Institute
Date of Request: March 15, 2010
Drawing Designator: SWC15

You requested that we find this system acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Requirements
Roadside safety systems should meet the guidelines contained in the NCHRP Report 350. FHWA Memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Description
The Louisiana 12-ft. Pinned F-Shape Portable Concrete Barrier (Louisiana Portable Barrier) specifies a restraining mechanism that limits lateral deflections of concrete barriers, is easy to install, inspect, and remove, and minimizes damage to the bridge deck or concrete pavements. This mechanism uses the pinned-down approach to restrain the barriers. Pins are simply dropped into designed inclined holes that start from the toe of the barrier and continue into the bridge deck or underlying concrete pavement.

The description of the crash tested Louisiana Portable Barrier is as follows. The precast concrete segments used in this crash test were 12.5-ft. long and had the standard F-shape profile. The as-tested barrier dimensions were 32 inches tall x 24 inches wide at the base x 9½ inches wide at the top. The horizontal barrier reinforcement consisted of eight no. 4 bars spaced at heights of 3¾ inches, 12 7/8 inches, 21 1/8 inches, and 29 3/8 inches from the bottom of the barrier within the vertical reinforcement. Vertical barrier reinforcement consisted of pairs of no. 4 bars spaced 18 inches on center. These vertical bars were bent in a "hook" fashion to conform to the F-shape barrier profile and to provide sufficient concrete cover for the drainage scupper and the horizontal inset at the base of the barrier. For the two vertical bar pairs adjacent to the ends of the barrier segments, the spacing was reduced to 16 ¾ inches and 9 inches respectively. Adjacent barrier segments were connected using a pin-and-loop type connection. The loops were made of ¾-inch diameter round stock steel. The outer diameter of the loops was 3½ inches and they extended 2 inches outside the end of the barrier segment. The barrier connection was comprised of two sets of three loops. When installed, the distance between adjacent barrier segments was ¼ inch. A 1-inch diameter x 30-inch long ASTM A449 connecting pin was inserted between the loops to establish the connection. A 2-inch diameter x ¼-inch thick washer was welded ¾ inch from the top of the connecting pin. The pin was held in place by resting the washer on insets built into the faces of adjacent barriers.

Two 1 7/8-inch diameter pinning holes, inclined at 40 degrees from pavement surface, were cast into the toe of each barrier segment. The holes started from the traffic face of the barrier and exited the near the barriers bottom centerline. After the crash test, the as-tested pinning hole detail was subsequently revised to a 4-inch x 1 7/8-inch slotted hole in order to accommodate existing bridge deck reinforcement when drilling the pinning hole into reinforced concrete. The pinning holes in the barrier were used as a guide to drill the 1¾-inch diameter holes into an un-reinforced concrete pavement. The depth of the holes inside the pavement was 6.25 inches when measured vertically. The average thickness of the unreinforced concrete pavement was 8 inches. The holes for the drop-pins were located 16 inches horizontally away from the ends of the barrier segments. A 1½-inch diameter x 21¼-inch long ASTM A36 steel drop-pin was placed into each hole. A ½-inch thick, 4-inchx4-inch A36 plate cover was welded to the top of each drop-pin. The plate covers were welded at a 5-degree angle from the vertical so that they matched the profile of the barrier toe.

Barrier segment reinforcement includes a 22-inch long U-shaped no. 4 bar placed diagonally at the location of each drop-pin hole. This U-shaped bar was placed around the drop-pin hole to provide resistance to drop-pin pullout in the event of concrete failure in the vicinity of the hole. The completed test installation consisted of eight barrier segments connected together for a total length of approximately 100 ft. Details of the barrier and the pin-down restraint are enclosed for reference.

Crash Testing

The Louisiana Portable Barrier was crash tested at the test facilities at Texas Transportation Institute Proving Grounds Riverside Campus. After the crash test, the test article showed tire marks and scrapes marring the face of the CMBs. The corner of segment 4 at the connection to segment 5 on the rear at ground level was broken. The drop-pins were pulled up as follows:

Pin 2A 0.5 inches; pin 2B 0.4 inches; pin 3A 2.6 inches; pin 3B 1.3 inches; pin 4A 1.9 inches; and pin 5A 0.4 inches. The drop-pins adjacent to the impact joint were deformed, but none of the pins pulled out of the concrete pavement. Segment 3 was pulled up on the end near segment 2 by 0.7 inches and on the end near segment 4 by 1.6 inches. Segment 4 was pulled up 1.4 inches near the end of segment 3 and by 1.0 inch at the end near segment 5. The vehicle contacted the installation 4.0 ft upstream of the joint between segments 3 and 4, and remained in contact for a total length of contact of 22 ft. Working width was 2.83 ft. Maximum permanent deformation of the barrier was 0.48 ft, and maximum dynamic deflection during the test was 0.96 ft.

Findings

We concur that the Louisiana 12-ft. Pinned F-Shape Portable Concrete Barrier successfully passed the requirements of NCHRP Report 350 Test Level 3. The occupant risk factors were within the preferred limits specified in NCHRP Report 350. Although the barrier sustained some damage that would require repair, there were no detached elements, fragments, or other debris that showed potential for penetrating the occupant compartment, or presented a hazard to workers or others in the area. Also noteworthy is the absence of significant damage to the underlying unreinforced concrete slab.

Please note the following standard provisions that apply to FHWA letters of acceptance:

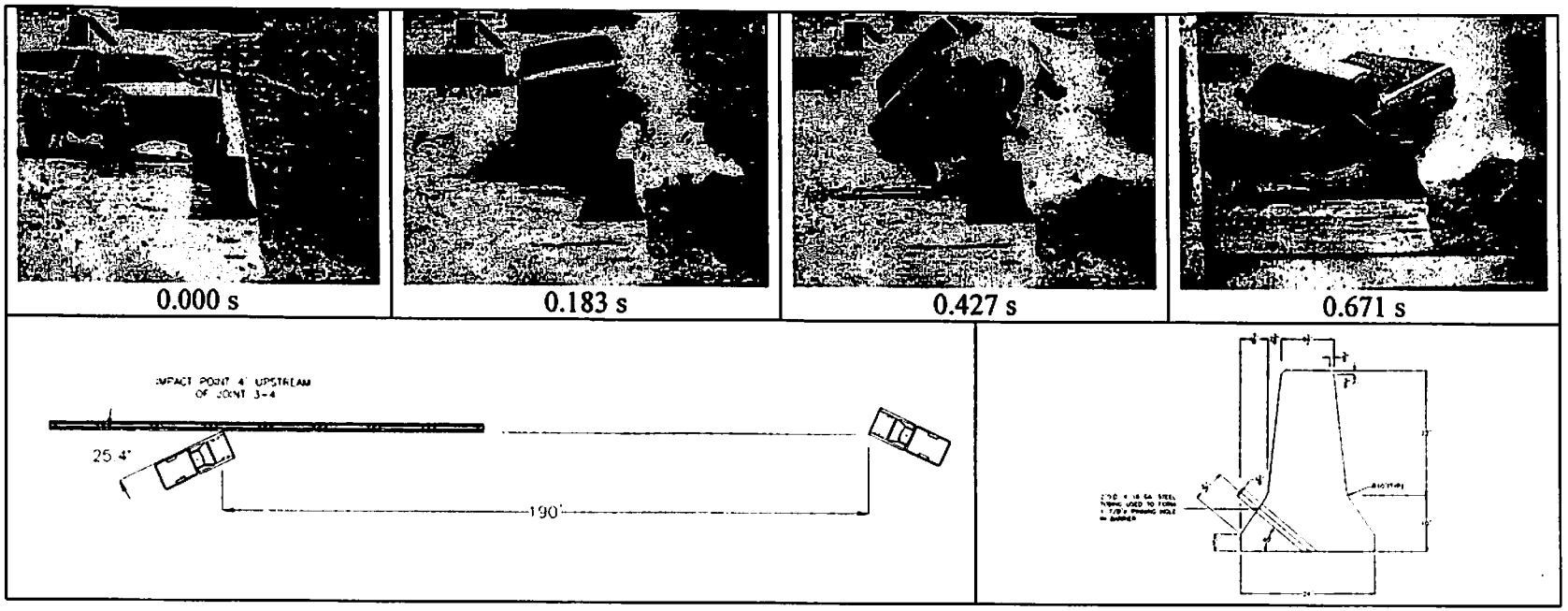
- This acceptance is limited to the crashworthiness characteristics of the system and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number B-206 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.

- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures



General Information
- Test Agency: Texas Transportation Institute
- Test No.: 405160-3-2a
- Date: 11-15-2007

Test Article
- Type: Pinned Temporary Barrier
- Name: Pinned F-Shape CMB
- Installation Length (ft): 100
- Material or Key Elements: 12.5 ft long F-shape precast concrete segments with pin-and-loop connection with two 1.875-inch diameter holes drilled into each barrier segment at 40 degrees with 1.75-inch diameter 21.25-inch long ASTM A36 steel drop-pin anchors
- Soil Type and Condition: Concrete Pavement, Dry

Test Vehicle
- Designation: 2000P
- Model: 2000 Chevrolet C2500 Pickup Truck
- Mass (lb)
  - Curb: 4993
  - Test Inertial: 4674
  - Dummy: No Dummy
  - Gross Static: 4674

Impact Conditions
- Speed (mi/h): 62.7
- Angle (deg): 25.4

Exit Conditions
- Speed (mi/h): Not
- Angle (deg): Obtainable

Occupant Risk Values
- Impact Velocity (ft/s)
  - Longitudinal: 20.3
  - Lateral: 19.0
- THIV (km/h): 28.9
- Ridedown Accelerations (g's)
  - Longitudinal: -6.4
  - Lateral: 4.7
- PHD (g's): 6.4
- ASI: 1.32
- Max. 0.050-s Average (g's)
  - Longitudinal: -8.7
  - Lateral: 9.7
  - Vertical: -5.6

Test Article Deflections (ft)
- Dynamic: 0.96
- Permanent: 0.48
- Working Width: 2.83

Vehicle Damage
- Exterior
  - VDS: 01LFQ5
  - CDC: 01FLEW5
  - Max. Exterior Vehicle Crush (inches): 21.7
- Interior
  - OCDI: RF0002000
  - Max. Occupant Compartment Deformation (inches): 1.1

Post-Impact Behavior
(during 1.0 sec after impact)
- Max. Yaw Angle (deg): 45
- Max. Pitch Angle (deg): -13
- Max. Roll Angle (deg): 41

Figure 5.18. Summary of results for *NCHRP Report 350* test 3-11 on the modified pinned F-shape barrier.

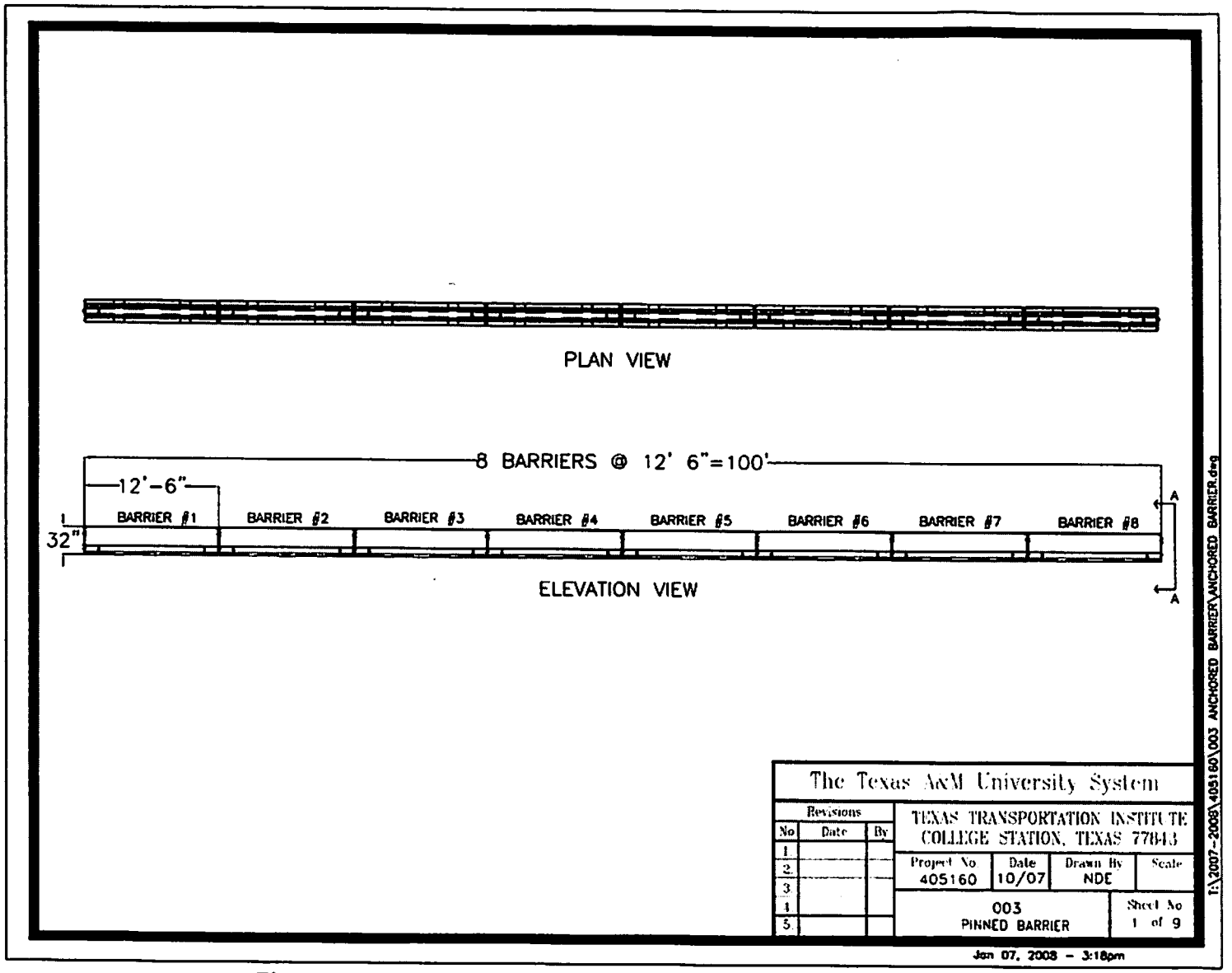


Figure 5.1. Details of the pinned F-shape barrier – installation layout.

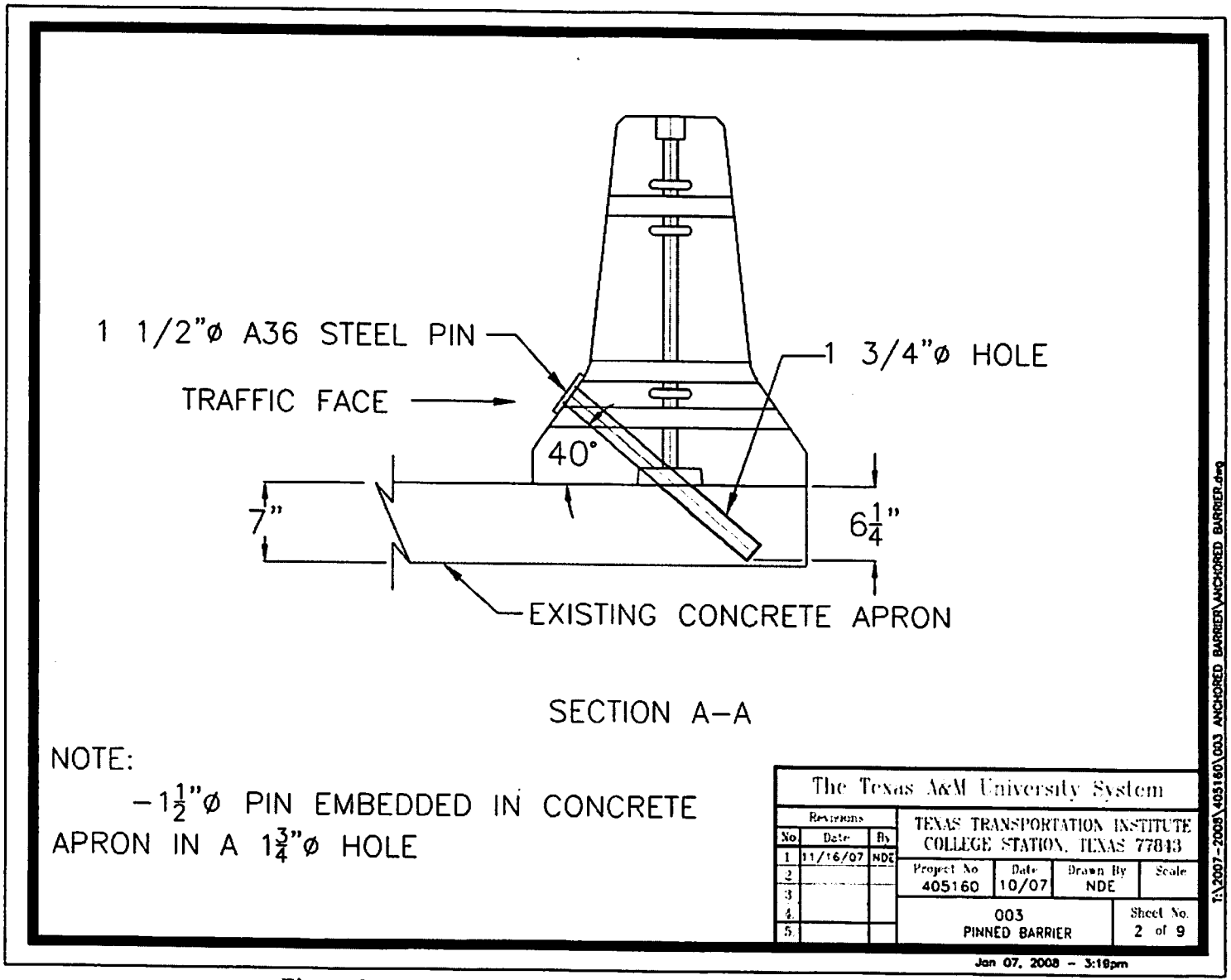


Figure 5.2. Details of the pinned F-shape barrier – Section A-A.

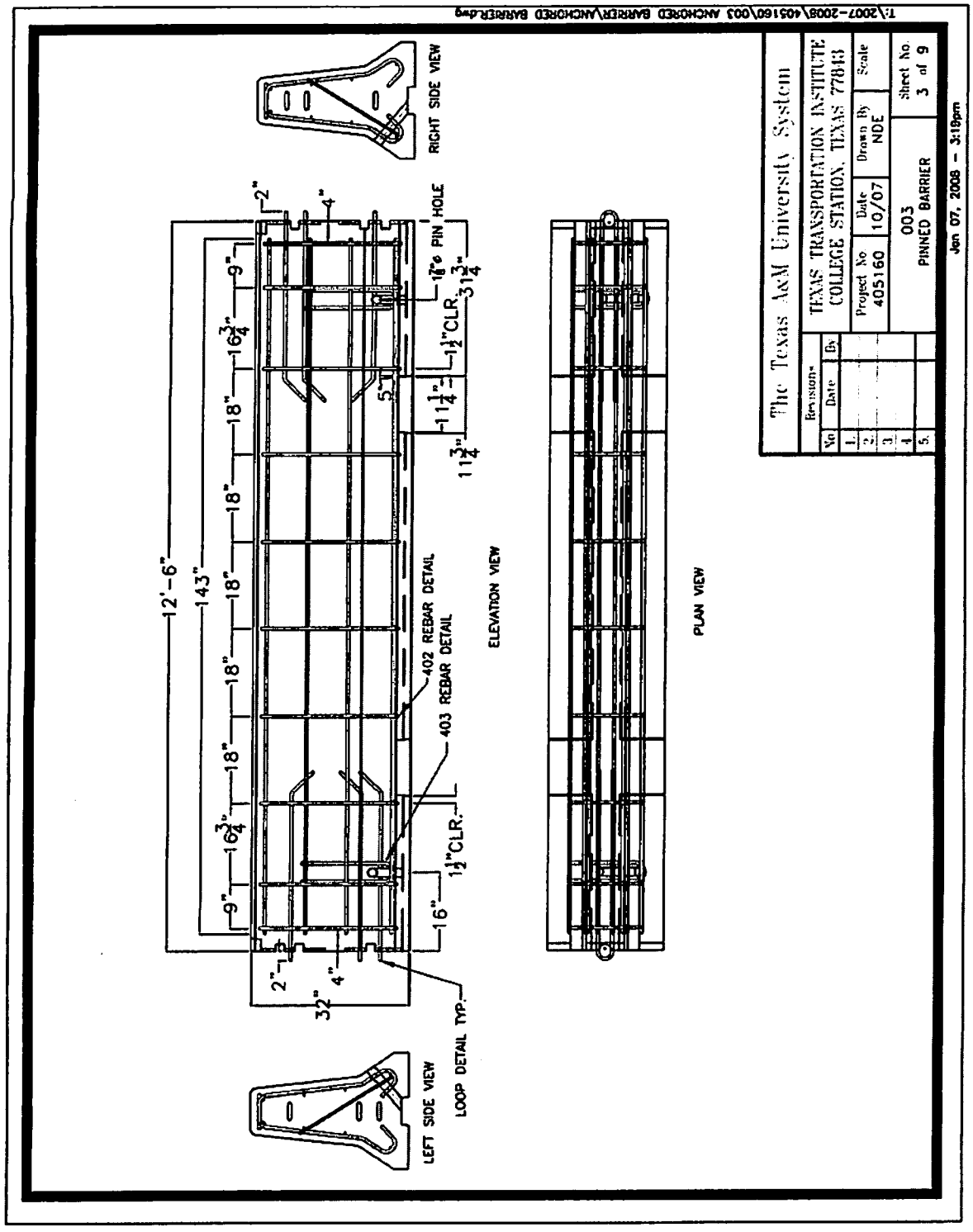


Figure 5.3. Details of the pinned F-shape barrier –segment detail.

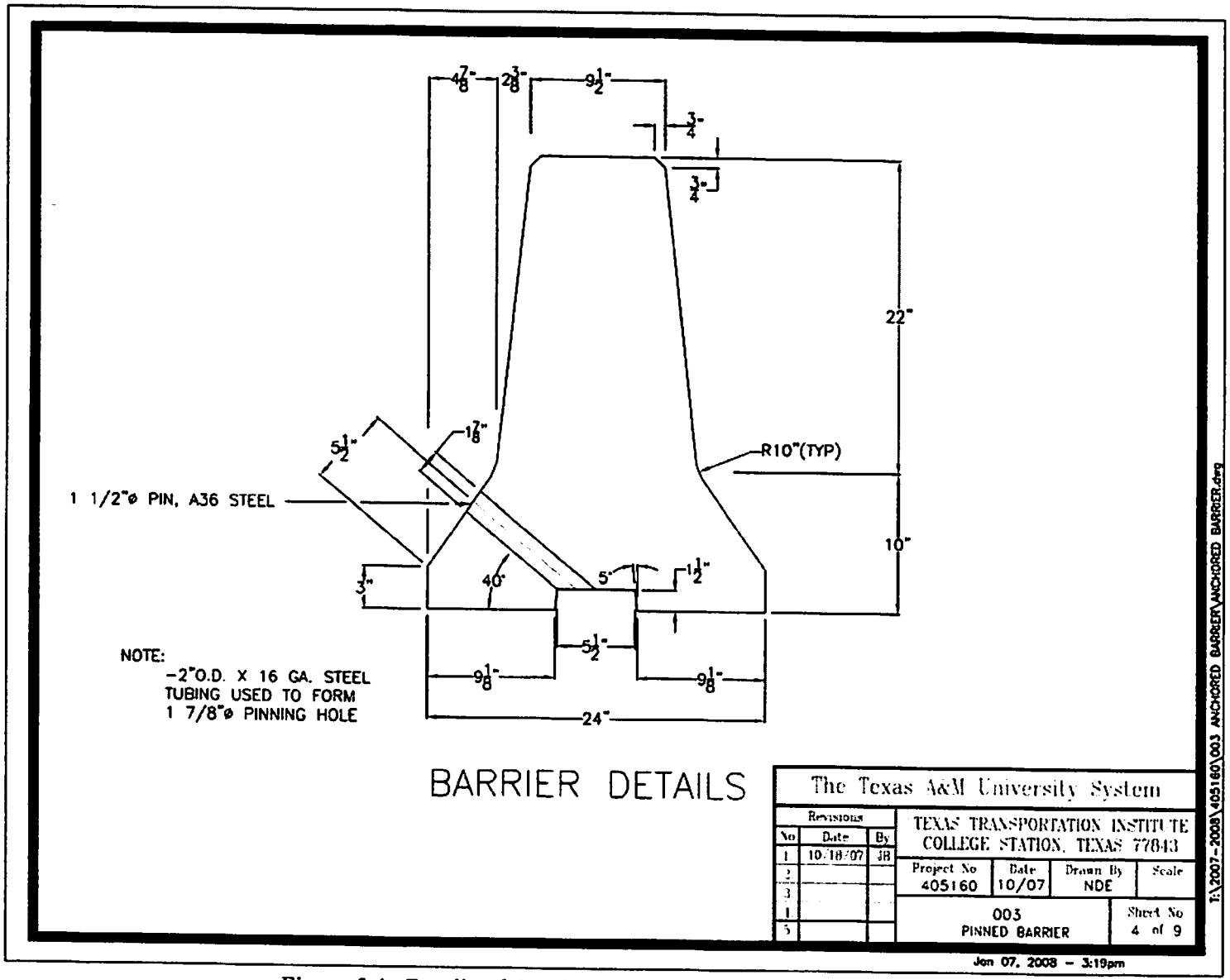


Figure 5.4. Details of the pinned F-shape barrier – cross section.

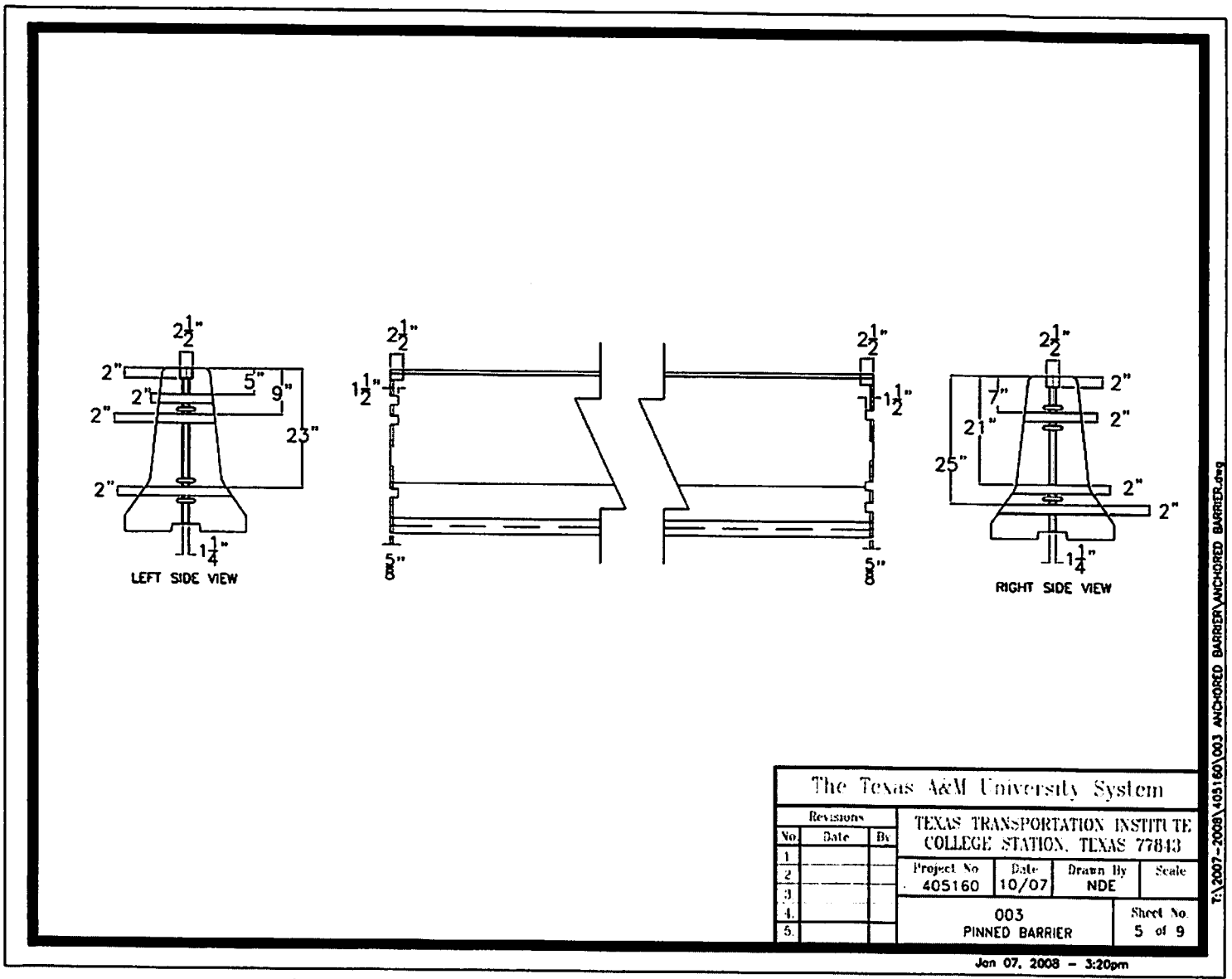


Figure 5.5. Details of the pinned F-shape barrier – barrier details.

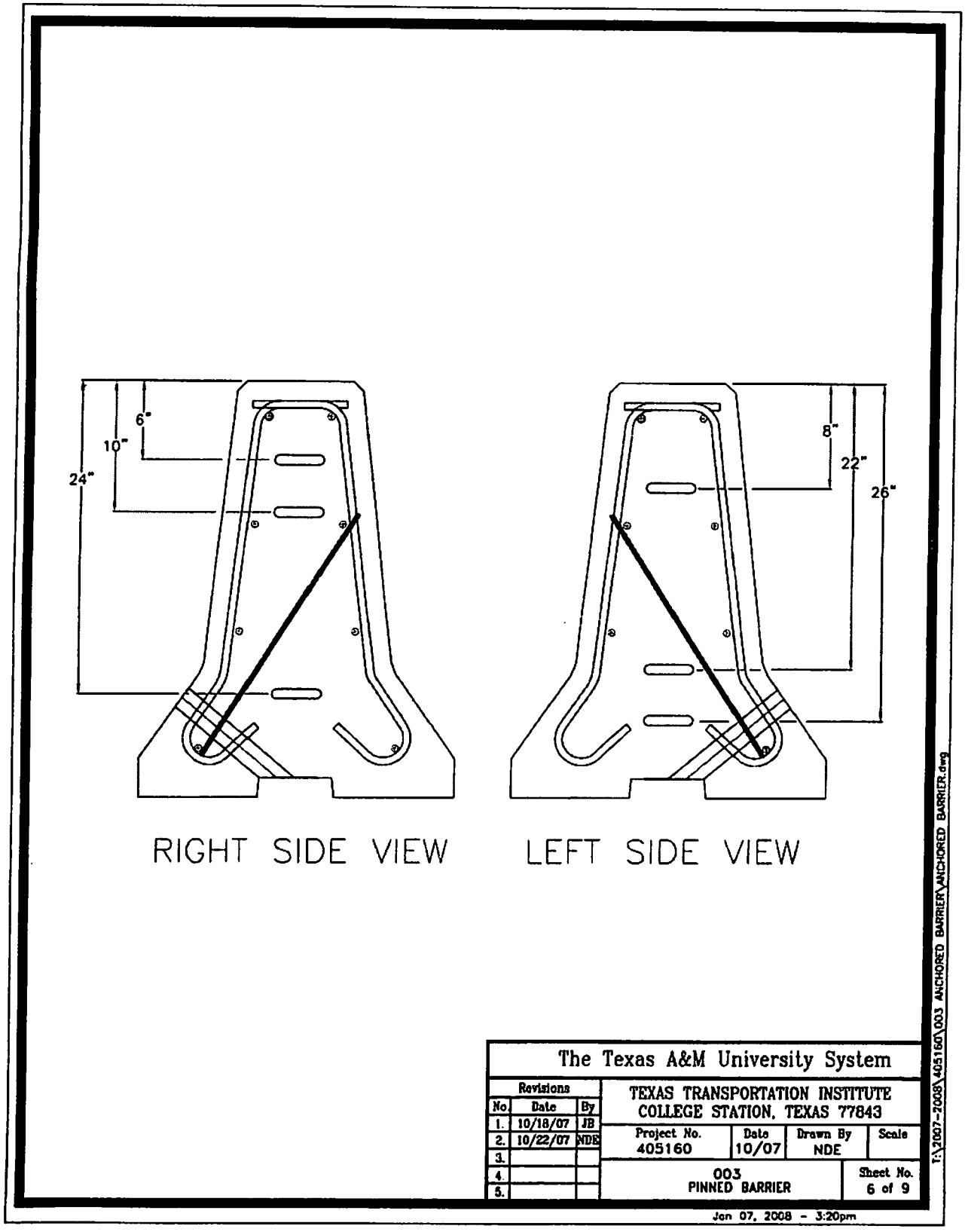


Figure 5.6. Details of the pinned F-shape barrier – pin placement.

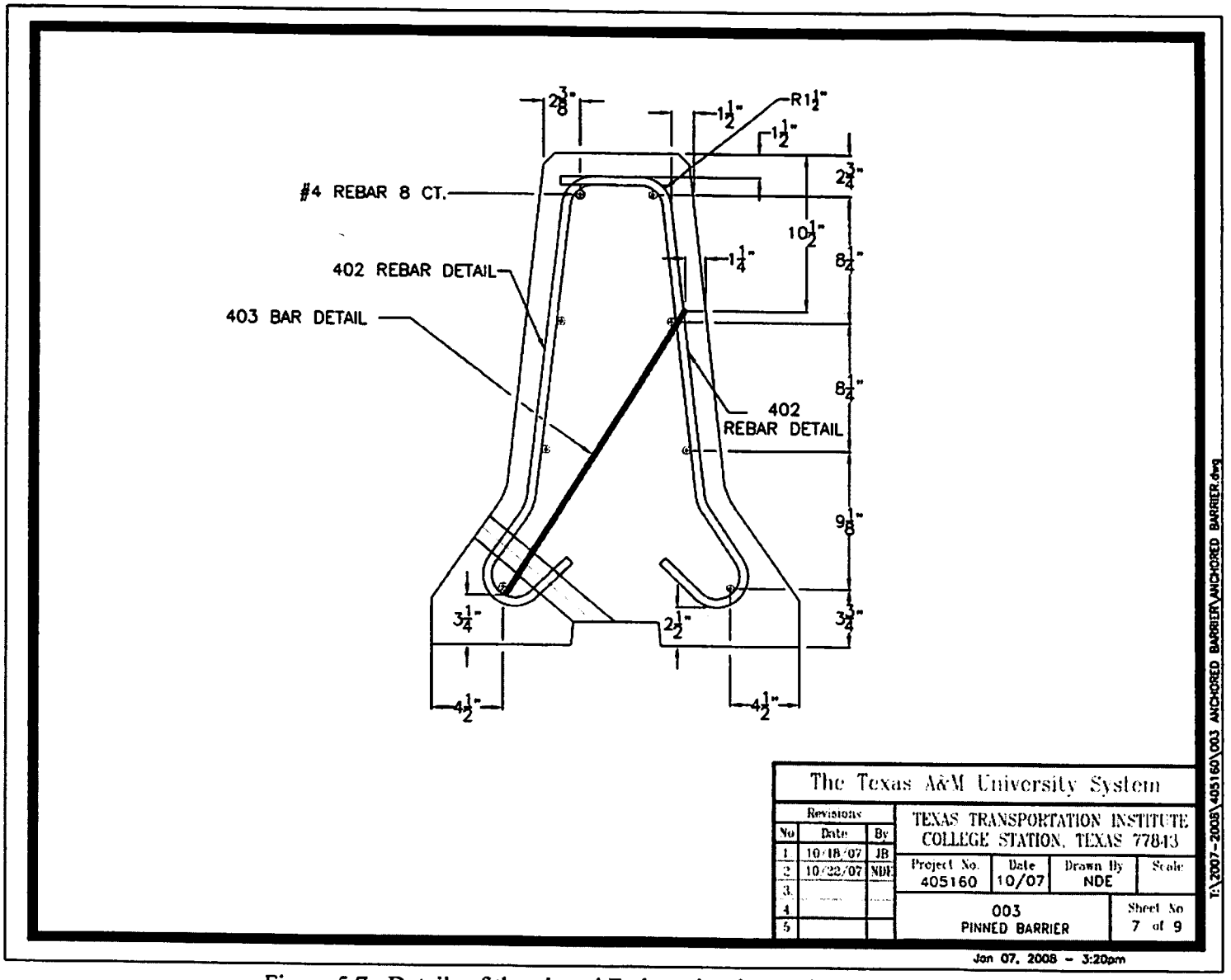


Figure 5.7. Details of the pinned F-shape barrier – rebar placement.

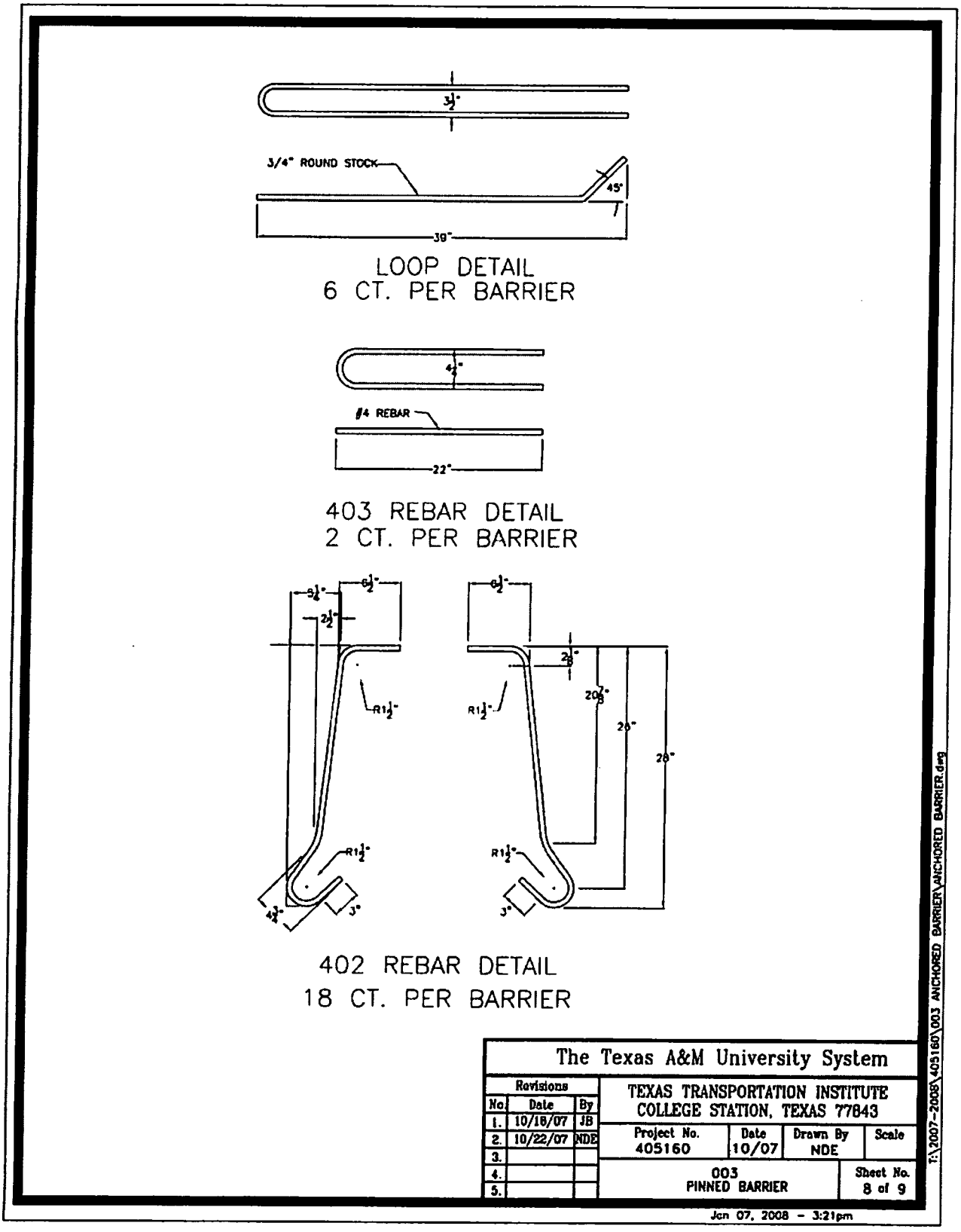


Figure 5.8. Details of the pinned F-shape barrier – rebar details.