Memo C-18: Pre-Authorized Wood Sand Jack and Proof Testing Guidelines

When wood sand jacks are used, the contractor has the following two options:

1. Construct and use the pre-authorized wood sand jacks detailed here (proof testing by the contractor is not required).
2. Construct, test, and use sand jacks that deviate from the pre-authorized wood sand jack (proof testing by the contractor is required) and provide testing data with their falsework shop drawings.

This memo provides proof testing guidelines for the second option, and details for both options.

Background

Wood sand jacks have been used without testing for a considerable length of time and have become increasingly larger, both in area and height. Contractors installed these onto substandard supports (e.g., rounded corbels), which caused sand jack bases to separate, resulting in sand loss and unexpected settlement. Wood materials have ranged from good solid lumber, with plywood bases, to attempts at using particle board bases. This necessitated the need for determining the protocol for sand jack use and testing.

The University of California, San Diego, conducted research using several configurations of sand jacks. A pre-authorized sand jack detail was developed with the protocols that were required for testing of other sand jacks.

Test Methods and Results

Wood sand jacks with two steel bands were loaded vertically by a steel plate attached to a hydraulic jack. A 3-inch thick piece of hardwood was used as a spacer to prevent the loading plate from loading the sides of the sand jack. The spacer replicated the hardwood wedges, and the steel plate at the bottom of the sand jack replicated the corbel typically used in the field for the sand jack to sit atop.

Figure C-18-1: Pre-Authorized Wood Sand Jack without Plastic Liner.

Figure C-18-2: Pre-Authorized Wood Sand Jack with Plastic Liner.

The capacity data was compiled for the two band wood sand jack with the following details:

1. Sides are 2″ x 6″ members.
2. Three 16d common nails at each corner joint.
3. Base is 1/2″ plywood.
4. Maximum spacing for the base nails is 7″.
5. Base nails are a minimum of 6d.
6. Plywood plunger is 1/2″ plywood.
7. Two single crimp 3/4″x 20 gage steel bands with 2000 lb yield strength.
8. Filler material is #30 sand, level with the top of the 2″ x 6″ side members.
9. No plastic liner is used.

The pre-authorized sample in Figure C-18-1 did not use a plastic liner, and Figure C-18-2 did use a plastic liner. Test results indicated that the plastic liner had no noticeable influence on the capacity or stiffness of the wood sand jacks.

The most common failure progressed as follows:

- First, the wood sand jack dilated. The sides bent outward and the corners began to separate. Often this was accompanied with sand leaking from the corners.
- Second, the nails attaching the plywood base to the side members tore out, resulting in the sand flowing through the joint along the bottom of the side members. Once the side members were no longer connected to the base, the lateral load was solely supported by the steel bands. Failure was consistently defined by slipping of the crimp connection of the lower band. At this point when the band connection failed, there was a sudden decrease in load carrying capacity of the wood sand jack, but not a total loss.
- Lastly, the compressed sand in the middle third of the box continued to support the load. After significant increase in displacement, the load carrying capacity would begin to increase. The residual strength of the sand jack, after losing the banding, was not investigated.

Figure C-18-3 depicts the load vs. displacement for the four configurations of sand jacks tested.

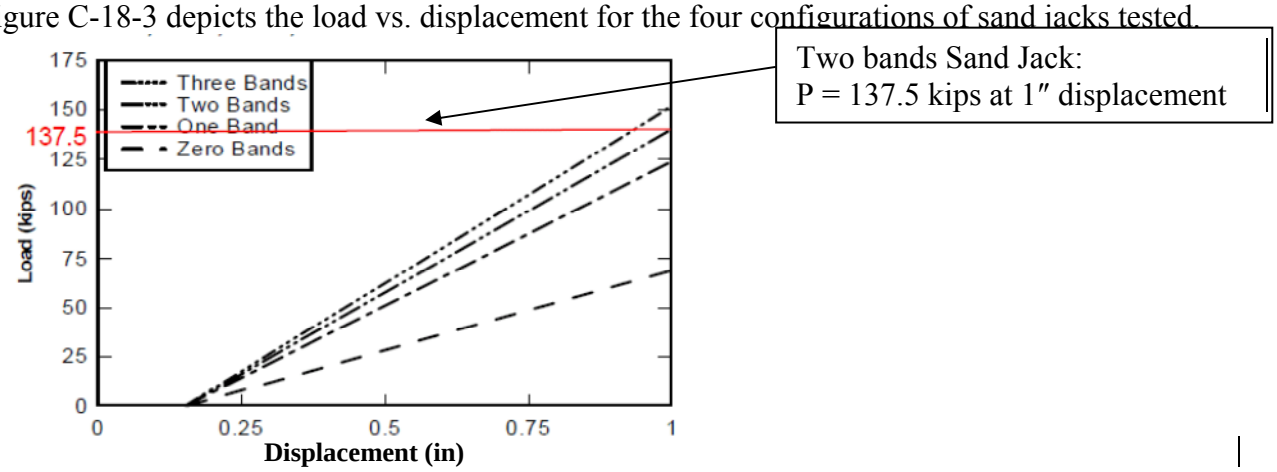

Figure C-18-3: Closer Look at Zero, One, Two, and Three Bands

Pre-Authorized Wood Sand Jack

The wood sand jack (Figure C-18-1) constructed with two steel bands around 2″ x 6″ side members nailed to a 1/2″ plywood base with 6d nails per side evenly spaced, filled with #30 sand and a 5/8″ Ext. BB plywood plunger bearing on it, has been tested and is authorized for use.

Pre-Authorized Wood Sand Jack Details

The wood sand jack with two steel bands as depicted in Figure C-18-4 has been reviewed and is authorized for use in falsework construction and removal. Additional proof testing by the contractor is not required. This wood sand jack can be used to withstand the following maximum allowable vertical load applied directly on the plunger:

No. of Bands	Allowable Load (Notes 1,2,3,4,5, 6, 8 & 9) (KIPS)	Anticipated Settlement (of wood sand jack only)
2 (Minimum)	68	½ ″

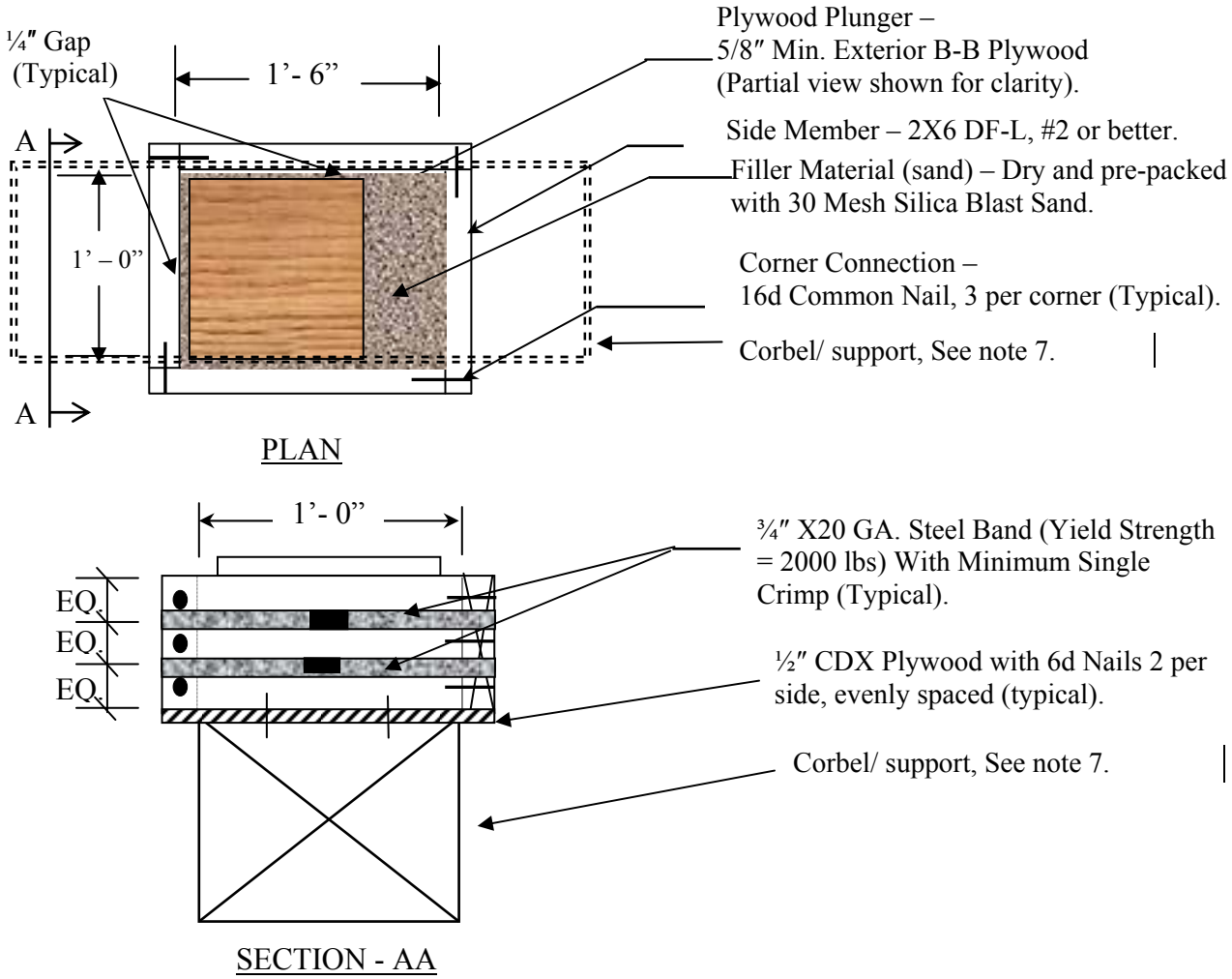

Figure C-18-4: Pre-Authorized Wood Sand Jack with Two Steel Bands

Notes for Figure C-18-4

1. No load increase may be taken for the use of additional band crimps.
2. Materials listed are minimum grade. Higher quality materials may be substituted. Materials should maintain their strength in wet conditions.
3. Reuse of sand jack is not allowed.
4. Plywood plunger resting on filler materials (sand) must have full bearing and must clear all side members by a maximum of 1/4″. Wood wedges used for falsework adjustment must have full bearing on plywood plunger and must be clear of side members of the sand jack.
5. Filler material (sand) should be level with top of 2″ x 6″.
6. Filler sand of wood sand jack must be fully supported.
7. Nails shall not be overdriven.

Use of the pre-authorized wood sand jack does not relieve the contractor from the responsibility to ensure that high quality material and workmanship is used to achieve the design load in field and the anticipated falsework settlement.

Proof Testing

Wood sand jacks designed by the contractor that deviate from the pre-authorized wood sand jacks must be proof tested using the following guidelines. These guidelines may also be used for sand jacks using steel or other suitable materials. Test criteria, evaluation and conclusion must be discussed with the Structure Construction Falsework Specialist prior to proof testing. The testing guidelines are as follows:

1. Compressive testing of the sand jack will be performed at an independent qualified testing laboratory with the following:
   - Proper facilities, including a compressive testing frame capable of applying the largest compressive force anticipated.
   - Written procedures for performing the compressive testing.
   - Operators who have received formal training for performing the compressive testing.
   - Annual calibration record of the compressive testing equipment performed by an independent third party with:
     a. Standards that is traceable to the *National Institute of Standards and Technology*.
     b. A formal reporting procedure that includes published test forms.
2. A minimum of three identical specimens must be tested for each wood sand jack proposed. Result = sum of three resultant tests divided by 6.
3. Test will measure the applied load and the vertical displacement of the plunger.
4. Each result must be twice the design load with less than 1″ vertical displacement of the plunger.
5. The proposed wood sand jack must be able to maintain the design load with less than 1/16″ increase of vertical displacement over 20 minutes. This load hold must be applied to all three specimens.
6. During load testing each load increment must be held for 1 minute prior to taking the displacement reading.

7. Contractor must include a statement certifying that:
    - All components of the tested wood sand jack duplicates field use of the proposed wood sand jack used in the falsework:
        a. Material type & size.
        b. Nailing pattern and or connection details.
        c. Banding and crimping.
        d. Plunger thickness and size.
        e. Filler material.
        f. Bearing area under sand jack.
    - For timber corbels, no crushing of the corbel shall be evident at the specified loading.
8. Test results must be certified and stamped by an engineer who is registered as a Civil Engineer in the State of California.
9. Contractor must notify Caltrans one week prior to performing proof testing.
10. Caltrans personnel must witness proof testing.
11. Proof test results for each proposed wood sand jack must be submitted with the falsework drawings every time it is specified on the drawings.