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RESEARCH REPORT: RR 25120
(CSI #04050)

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GENERAL APPROVAL – Renewal - Simpson Strong-Tie ET 22 Epoxy Anchors for use in unreinforced masonry walls.

DETAILS

The Simpson Strong-Tie ET 22 Epoxy Anchors are approved for use in resisting short duration lateral loads such as seismic and wind loads. The system shall not be used for sustained gravity loading conditions.

The system is a two-component adhesive with each component contained in dual side by side cartridges. The cartridge is placed in either a pneumatic injector tool or a hand-powered tool. The two components are thoroughly mixed together when they are forced through a spiral motionless mixing nozzle which is attached to the cartridges. The mixing nozzle may be either 3/8" diameter or 1/2" diameter depending on the desired flow rate. The two components are mixed in a 1:1 volume ratio.

The stud assembly used for shear and/or tension applications where the outside of the wall is accessible consists of a length of 5/8-inch diameter rod and is used in conjunction with a 13/16-inch outside diameter by 11/16-inch inside diameter steel sleeve, 8-inches in length, a 31/32-inch diameter wire mesh screen tube, and a steel plate measuring 6" x 6" x 3/8". The plate is bolted to the opposite side of the wall and serves to resist the tension loads. The steel sleeve is the component which is epoxied to the wall and serves to transfer the shear load from the anchor rod to the wall. The threaded rods are supplied in various lengths depending on the application. The steel sleeve has a plastic plug at the end to prevent entry of adhesive during installation.

The stud assembly used to resist shear loads only consists of a length of 3/4-inch diameter rod and is used in conjunction with 31/32-inch diameter by 8-inch long wire mesh screen tube. The threaded rods are supplied in various lengths depending on the application

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The stud assembly used to resist tension and/or shear loads where the outside of the wall is not accessible consists of a length of 3/4-inch diameter rod used in conjunction with a 31/32-inch outer diameter wire mesh screen tube. The threaded rods and the screen tube vary in length depending on the installation depth required, and the rods are prebent to a 22½° angle.

The threaded rods are zinc-plated and meet ASTM A 307 specifications. The threads on the anchor rods conform to ANSI Specification B1.1 "Unified Screw Threads". The screen tubes are made of steel wire cloth that are folded over at one end and welded closed.

The epoxy anchor systems are approved for installation in existing unreinforced solid masonry walls subject to the following conditions:

1. Each anchor rod shall bear a permanent identification indicating the manufacturer's name or symbol.
2. Use of the ET 22 Anchor System shall be approved by the engineer of record.
3. Installation of the anchors shall be in accordance with the manufacturer's instructions except as otherwise stated in this report.
4. Weld connections to the zinc plated threaded rods are allowed only if all of the zinc coating is removed from the weld area prior to welding. Welded connections shall comply with Section 2204.1 of the 2014 Los Angeles City Building Code. Welds shall be made prior to installation of the anchors of the wall. An approved equivalent corrosion resistant coating (such as hot-dip zinc coating or red oxide paint) must be reapplied after welding.
5. Wall thickness shall be a minimum of 3 wythes and 13".
6. A called building inspection is required prior to the installation of bolts to verify:
 - a. Installer qualification.
 - b. Component identification.
7. Drilling holes for bolt installations shall be done with a non-impact electric rotary drill. Impact tools shall not be used for drilling holes or tightening anchors rod nuts.
8. The minimum mortar quality in 80% of the in-place shear tests as required by Section 8809.5.3 of the 2014 Los Angeles City Building Code shall not be less than the total of 30 psi plus the axial stress in the wall at the point of the test.
9. The anchors may be installed above the intersection of the roof sheathing with the wall, only where:

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- a. Additional in-plane shear tests have been performed above the roof intersection at representative locations. A minimum of one test per each wall direction shall be performed.
 - b. The minimum quality mortar in each of the tests shall not be less than 50 psi.
10. The installed anchor shall not be disturbed until the adhesive has cured. See Table Nos. 1 and 2 for minimum cure time.

TABLE NO. 1
Recommended hardening times for ET 22 Anchors

Substrate Temperature (°F)	Torque Time (hours)	Minimum Cure Time (hours)
40-50	18	72
51-60	12	48
61-70	6	24
71-80	5	24
81	4	24

11. No gaps shall appear between the anchoring device and the masonry.
12. For use of the wall anchors in shear only:
- a. Design shear shall not exceed 1000 pounds with no increase for lateral loading.
 - b. One-fourth (25%) of the anchors or the steel sleeves shall be tested by a Registered Deputy Building Inspector using a torque calibrated wrench to a minimum torque of 60 foot-lbs. All requirements of Earthquake Safety Section, Guideline No. 3, "Torque Testing Grouted Bolts and Anchors" shall be met.
13. For use of the wall anchor in tension and/or shear:
- a. Design tension load for the 22½° anchor shall not exceed 1200 pounds. Design shear loads shall not exceed 1000 pounds. No increase for lateral loading is allowed.
 - b. Tension tests shall be performed on anchors installed at an angle of 22.5 degrees. Testing shall be performed by a testing laboratory approved by the City of Los Angeles for in-place anchor testing. A minimum of 5% of the anchors shall be tested with a minimum of two tests. Where the wall thickness varies, at least one test shall be performed on an anchor which has the least amount of embedment. All tension tests must be performed without blocking, ledgers or hardware in place. The tests shall show that anchors can maintain a tensile load of 3000

pounds for a period of 5 minutes, using the equipment and procedures as follows. Load dissipation shall be no more than 10% deviation from the initially applied load.

Acceptable test equipment includes any suitable testing or loading system which permits the following conditions to be met. Test equipment must not bear against the epoxy. The testing device shall be of sufficient capacity to prevent yielding of its various components and shall ensure that the applied tension load remains parallel to the axis of the anchor during testing. Forces applied to the test rod must be perpendicular to the surface of the brick wall. A continuous increase in load must be applied to the test anchor until the final test load is reached. Any suitable measurement device accurate to at least 0.001" shall be used to measure horizontal displacement of the anchor relative to the face of the wall. The loading system must be calibrated and be capable of measuring forces to an accuracy within $\pm 2\%$ of the applied load.

Test procedures are as follows:

1. Measure projection of rod from face of wall to verify anchor embedment.
2. Attach test system and measuring device to anchors. The measuring device shall be positioned on the anchors as close to the wall as possible.
3. Measure and record the initial displacement between a marked point on wall and reference point on anchor.
4. Apply 3000 pound test load.
5. After 5 minutes, record the remaining test load and record the final displacement between the marked point on wall and reference point on anchor.

The test report shall include:

1. Test location(s).
2. Brick/mortar condition.
3. Wall thickness.
4. Embedment depth of anchor.
5. Applied load.
6. Remaining tension test load after 5 minutes.

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7. Anchor displacement: Allowable displacement is no more than 1/8".

8. Calibration of the tension load test system.

Should any of the anchors fail the above criteria, all of the anchors shall be tested and replaced or substituted as necessary. The test results shall be submitted directly to the Earthquake Inspection Section of the Commercial Building Inspection Division for all jobs tested.

- c. 22 1/2° anchors shall be installed under continuous inspection per Guideline No. 3 of the Earthquake Safety Section
14. The minimum spacing for anchors used to resist shear loads and combination through bolts shall be 16" o.c. each way.
15. The minimum spacing for 22.5 degree anchors shall be 24" o.c. each way.
16. The minimum edge distance for all anchors shall be 24".

DISCUSSION

The report is in compliance with the 2014 Los Angeles City Building Code.

The approval is based on tests. The tests were performed on three existing unreinforced solid masonry buildings.

The manufacturer's recommended cure times is listed in Table No. 1. Minimum cure time is the time required prior to application of allowable (design) tensile and shear loads. The anchors should not be torqued for the minimum torque time specified. Cure time is the time required for the epoxy to reach ultimate strength. The anchors are not recommended for installation in a substrate with temperature lower than 40°F.

The manufacturer's instructions for the anchor installations are as follows:

One inch diameter holes are drilled in the mortar joints or in the brick for all three type of anchors. The drill bits used must meet ASNI Specifications B94.12-77. Impact tools shall not be used. The holes are cleaned of dust and debris using a nylon brush and compressed air.

Epoxy is injected into the screen tubes until the tubes are completely full and then placed into the drilled holes. Threaded rod or steel sleeves (depending upon application) are then slowly pushed into the screen tube while continuously rotating. If no epoxy is forced back out the hole, the rod or sleeve should be removed and more epoxy injected into the screen. The rod or sleeve should be reinserted into the screen as soon as possible.

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Holes for the through-bolted combination tension/shear anchors are drilled completely through the wall. After the sleeve has been installed and the epoxy has been given time to cure, a 5/8"-diameter drill bit is used to drill through the plastic plugs in the steel sleeves. A 5/8"-diameter threaded rod is then pushed through to the other side. A metal plate and nut are attached to the end of the rod on the exterior side of the wall.

Holes for the combination tension/shear anchors installed at 22.5 degrees are drilled using a 22.5 degree guide to keep the drill bit at the correct angle. The angled hole is to be drilled in the vertical plane only. The holes are drilled a minimum of 13" deep and must extend to within one inch of the outer face without going all the way through the wall.

Holes for the 3/4"-diameter anchors resisting only shear loads are drilled to a depth of 8" and are installed with a screen as described above.

This general approval of an equivalent alternate to the Code is only valid where an engineer and/or inspector of this Department has determined that all conditions of this approval have been met in the project in which it is to be used.

Addressee to whom this Research Report is issued is responsible for providing copies of it, complete with any attachments indicated, to architects, engineers and builders using items approved herein in design or construction which must be approved by Department of Building and Safety Engineers and Inspectors.

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