AMENDED IN ASSEMBLY MARCH 30, 1995

CALIFORNIA LEGISLATURE—1995–96 REGULAR SESSION

ASSEMBLY BILL No. 1314

Introduced by Assembly ~~Member Sher~~ *Members Sher, Richter, and Woods*

February 23, 1995

An act to add Chapter 4.5 (commencing with Section 18944.30) to Part 2.5 of Division 13 of the Health and Safety Code, relating to buildings.

LEGISLATIVE COUNSEL'S DIGEST

AB 1314, as amended, Sher. Buildings: straw-bale structures.

(1) Existing law, known as the State Building Standards Law, creates the California Building Standards Commission and authorizes it to review proposed building standards, adopt or reject these proposed standards, and codify and publish the adopted standards in the California Building Standards Code. Local agencies have the responsibility for the enforcement of numerous provisions of the California Building Standards Code.

This bill would amend the State Building Standards Law to establish minimum standards of safety for the construction of structures that use baled straw, as defined, as a structural or nonstructural material. Notwithstanding any other provisions of law, this bill would apply to all structures using straw bales in the construction of wall systems. Because the bill would

impose new duties on local enforcement agencies, the bill would constitute a state-mandated local program.

(2) The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement, including the creation of a State Mandates Claims Fund to pay the costs of mandates that do not exceed $1,000,000 statewide and other procedures for claims whose statewide costs exceed $1,000,000.

This bill would provide that, if the Commission on State Mandates determines that the bill contains costs mandated by the state, reimbursement for those costs shall be made pursuant to these statutory provisions.

Vote: majority. Appropriation: no. Fiscal committee: yes. State-mandated local program: yes.

The people of the State of California do enact as follows:

SECTION 1. Chapter 4.5 (commencing with Section 18944.30) is added to Part 2.5 of Division 13 of the Health and Safety Code, to read:

CHAPTER 4.5. STRAW-BALE STRUCTURES

Article 1. General Provisions and Definitions

18944.30. (a) The Legislature finds and declares all of the following:

(1) There is an urgent need for low-cost, energy-efficient housing in California.

(2) The cost of conventional lumber-framed housing has risen due to a shortage of construction-grade lumber.

~~(3) Baled rice straw can provide an energy efficient substitute for stud-framed wall construction for low-income housing.~~

~~(4) The state has mandated by statute that all autumn burning of rice straw stubble be prohibited by the year 2000 in an annual phased reduction.~~

~~(5) Several alternatives to burning methods of preventing rice stem rot have been developed. Among these are autumn flooding of rice fields and chopping and soil incorporation of the rice straw.~~

~~(6) Autumn flooding of rice fields provides increased waterfowl habitat while decomposing rice straw. This technique has been adopted by rice growers for up to 100,000 acres of ricelands.~~

~~(7) Autumn flooding, while providing waterfowl benefits, has the potential to impact salmon fisheries due to the diversion of surface water via unscreened diversions at a time of year when juvenile salmon are migrating to sea. Autumn flooding is a new use of California's scarce water resources, and it exists outside conventional water rights, creating a potential to impact water storage.~~

~~(8) Other alternatives to rice stubble burning exist, but they are too costly to be economical for rice growers. Among those alternatives is the practice of baling the straw and removing it from the fields. At present, no viable market for baled rice straw exists.~~

~~(9)~~

(3) Rice straw is an annually renewable source of cellulose that can be used as an energy-efficient substitute for stud-framed wall construction.

(4) The state has mandated that the burning of rice straw be prohibited as specified in statute by the year 2000 in an annual phased reduction.

(5) As a result of the mandated burning reduction, growers are experimenting with alternative straw management practices. Various methods of straw incorporation into the soil are the most widely-used alternatives. The two most common methods are nonflood incorporation and winter flood incorporation. Economically viable off-farm uses for rice straw are not yet available.

(6) Winter flooding of rice fields encourages the natural decomposition of rice straw and provides valuable waterfowl habitat. According to the Central Valley Habitat Joint Venture component of the North

American Waterfowl Management Plan, in California's Central Valley, over 400,000 acres of enhanced agricultural lands are needed to restore the depleted migratory waterfowl populations of the Pacific flyway. Flooded rice fields are a key and integral part of the successful restoration of historic waterfowl and shorebird populations.

(7) Winter flooding of rice fields provides significant waterfowl habitat benefits and should be especially encouraged in areas where there is minimal potential to impact salmon as a result of surface water diversions.

(8) An economically viable market for rice straw bales could result from the use of rice straw bales in housing construction.

~~(10)~~

(9) The present requirement for costly design engineering in the Uniform Building Code is severely restricting the development of straw bale housing.

~~(11)~~

(10) A statutory design code for the use of straw-bale housing would significantly benefit low-cost housing, agriculture, and fisheries in California.

(b) It is, therefore, the intent of the Legislature to establish minimum standards of safety for the construction of structures that use baled straw as a structural or nonstructural material.

18944.31. Notwithstanding any other provision of law, this chapter shall apply to all structures utilizing straw bales in the construction of wall systems.

18944.33. For the purposes of this chapter, the following terms are defined as follows:

(a) ''Bales'' means rectangular compressed blocks of straw, bound by strings or wire.

(b) ''Flakes'' means slabs of straw removed from an untied bale. Flakes are used to fill small gaps between the ends of stacked bales.

(c) ''Laid flat'' refers to stacking bales so that the sides with the largest cross-sectional area are horizontal and the longest dimension of this area is parallel with the wall plane.

(d) ‘‘Laid on-edge’’ refers to stacking bales so that the sides with the largest cross-sectional area are vertical and the longest dimension of this area is horizontal and parallel with the wall plane.

(e) ‘‘Straw’’ means the dry stems of cereal grains left after the seed heads have been removed.

Article 2. Materials

18944.35. (a) Bales shall be rectangular in shape.

(b) Bales used within a continuous wall shall be of consistent height and width to ensure even distribution of loads within wall systems.

(c) Bales shall be bound with ties of either polypropylene string or baling wire. Bales with broken or loose ties shall not be used unless the broken or loose ties are replaced with ties which restore the original degree of compaction of the bale.

(d) The moisture content of bales, at time of installation, shall not exceed 20 percent of the total weight of the bale. Moisture content of bales shall be determined by either of the following methods:

(1) A suitable moisture meter, designed for use with baled straw or hay, and equipped with a probe of sufficient length to reach the center of the bale, shall be used to determine the average moisture content of five bales randomly selected from the bales to be used.

(2) A total of five samples, one taken from the center of each of five bales randomly selected from the bales to be used, shall be tested for moisture content by a testing lab approved by the commission.

(e) Bales shall have a minimum calculated density of 7.5 pounds per cubic foot.

(f) Where custom-made partial bales are used, they shall be of the same density, same string or wire tension, and, where possible, use the same number of ties as the standard size bales.

(g) Bales of various types of straw, including wheat, rice, rye, barley, oats, and similar plants, as determined by the commission, shall be acceptable if they meet the

minimum requirements of this chapter for density, shape, moisture content, and ties.

Article 3. Construction Requirements

18944.40. (a) Straw-bale walls, when covered with plaster, drywall, or stucco, shall be deemed to have the equivalent fire resistive rating as wood-frame construction with the same wall-finishing system.

(b) Minimum bale wall thickness shall be 13 inches.

(c) Buildings with structural bale walls shall not exceed one story in height, and the unloaded bale portion of the wall shall not have a width-to-height ratio less than 0.18 (for example, the maximum height for a wall that is 28 inches in width would be 10 feet minus 8 inches), unless the structure is designed by an engineer or architect licensed by the state to practice, and approved by the building official.

(d) The ratio of unsupported wall thickness to wall length shall not be less than 0.064 (for a wall that is 28 inches in width, the maximum unsupported length allowed is 80 feet), unless the structure is designed by an engineer or architect licensed by the state to practice, and approved by the building official.

(e) Straw-bale structures shall be designed to withstand all vertical and horizontal loads as specified in the code.

(f) Foundations shall be sized to accommodate the thickness of the bale wall and the load created by the wall and roof live and dead loads. Foundation (stem) walls which support bale walls shall extend to an elevation of not less than six inches above adjacent ground at all points. The minimum width of the footing shall be the width of the bale it supports, except that the bales may overhang the exterior edge of the foundation by not more than four inches to accommodate rigid perimeter insulation. Footings shall extend a minimum of 12 inches below natural, undisturbed soil, or to the frost line, whichever is lower.

(g) (1) Vertical reinforcing bars with a minimum diameter of one-half inch shall be embedded in the foundation *to* a minimum depth of seven inches, and shall extend above the foundation by a minimum of 12 inches. These vertical bars shall be located along the center line of the bale wall, spaced not more than two feet apart. A vertical bar shall also be located within one foot of any opening or corner, except at locations occupied by anchor bolts.

(2) Nonbale walls abutting bale walls shall be attached by means of one or more of the following methods or by means of an acceptable equivalent:

(A) Wooden dowels of five-eighths inch minimum diameter and of sufficient length to provide 12 inches of penetration into the bale, driven through holes bored in the abutting wall plate, and spaced to provide one dowel connection per bale.

(B) Pointed wooden stakes, a minimum of 12 inches in length and one and one-half inches by three and one-half inches at the exposed end, fully driven into each course of bales, as anchorage points.

(C) Bolted or threaded rod connection of the abutting wall, through the bale wall, to a steel nut and steel or plywood plate washer, a minimum of six inches square and a minimum thickness of eight-sixteenths inch for steel and one-half inch for plywood, in a minimum of three locations.

(3) (A) Structural bale walls shall be anchored to the foundation at intervals of six feet or less. There shall be embedded in the foundation a minimum of two one-half inch diameter steel anchor bolts per wall, with one bolt located within 36 inches of each end of each wall. Sections of one-half inch diameter threaded rod shall be connected to the anchor bolts, and to each other, by means of threaded coupling nuts, and shall extend through the roof plate and be fastened with a steel washer and nut.

(B) Straw-bale walls and roof plates may be anchored to the foundation by means of other methods which are adequate to resist uplift forces resulting from the design

wind load. There shall be a minimum of two points of anchorage per wall, spaced not more than six feet apart, with one located within 36 inches of each end of each wall.

(C) With structural bale walls, the dead load of the roof and ceiling systems shall produce vertical compression of the walls. Regardless of the anchoring system used to attach the roof plate to the foundation, prior to installation of wall finish materials, the finish materials shall be retightened to compensate for this compression.

(h) (1) A moisture barrier shall be used between the top of the foundation and the bottom of the bale wall to prevent moisture from migrating through the foundation so as to come into contact with the bottom course of bales. This barrier shall consist of one of the following:

(A) Cementitious waterproof coating.

(B) Type 30 asphalt felt over an asphalt emulsion.

(C) Sheet metal flashing, sealed at joints.

(D) Another building moisture barrier, as approved by the commission.

(2) All penetrations through the moisture barrier, as well as all joints in the barrier, shall be sealed with asphalt, caulking, or an approved sealant.

(i) (1) For nonstructural walls, bales may be laid either flat or on-edge. Bales in structural walls shall be laid flat and be stacked in a running bond, where possible, with each bale overlapping the two bales beneath it. Overlaps shall be a minimum of 12 inches. Gaps between the ends of bales which are less than six inches in width may be filled by an untied flake inserted snugly into the gap.

(2) The first course of bales shall be laid by impaling the bales on the rebar verticals and threaded rods, if any, extending from the foundation. When the fourth course has been laid, vertical #4 rebar pins, or an acceptable equivalent, long enough to extend through all four courses, shall be driven down through the bales, two in each bale, located so that they do not pass through the space between the ends of any two bales. The layout of these rebar pins shall approximate the layout of the rebar

pins extending from the foundation. As each subsequent course is laid, two pins, long enough to extend through that course and the three courses immediately below it, shall be driven down through each bale. This pinning method shall be continued to the top of the wall. In walls seven or eight courses high, pinning at the fifth course may be eliminated.

(3) When the third course has been laid, vertical #4 rebar pins, or an acceptable equivalent, long enough to extend through all three courses, shall be driven down through the bales, two in each bale, located so that they do not pass through the space between the ends of any two bales. The layout of these rebar pins shall approximate the layout of the rebar pins extending from the foundation. As each subsequent course is laid, two pins, long enough to extend through that course and the two courses immediately below it, shall be driven down through each bale. This pinning method shall be continued to the top of the wall.

(4) Only full-length bales shall be used at corners of structural walls, unless exceptions are approved by an engineer or architect licensed by the state to practice.

(5) Vertical #4 rebar pins, or an acceptable alternative, shall be located within one foot of all corners or door openings.

(6) Staples, made of #3 or larger rebar formed into a ‘‘U’’ shape, a minimum of 18 inches long with two six-inch legs, shall be used at all corners of every course, driven with one leg into the top of each abutting corner bale.

(j) (1) All structural bale walls shall have a roof plate at the top of the walls to bear the roof load and to provide a means of connecting the roof structure to the foundation. The roof plate shall be continuous along the tops of structural walls.

(2) An acceptable roof plate option consists of two double two-inch by six-inch, or larger, horizontal top plates, one located at the inner edge of the wall and the other at the outer edge. Connecting the two doubled top plates, and located horizontally and perpendicular to the length of the wall, shall be two-inch by six-inch cross

members, spaced no more than 72 inches center to center, and as required to align with the threaded rods extending from the anchor bolts in the foundation. The double two-inch by six-inch top plates shall be face nailed with 16d nails staggered at 16-inch o.c., with laps and intersections face nailed with four 16d nails. The cross members shall be face nailed to the top plates with four 16d nails at each end. Corner connections shall include overlaps nailed as above or an acceptable equivalent, such as plywood gussets or metal plates. Alternatives to this roof plate option shall provide equal or greater horizontal and vertical rigidity.

(3) The connection of roof framing members to the roof plate shall comply with the appropriate sections of the code.

(k) All openings in structural bale walls shall be a minimum of one full bale length from any outside corner, unless exceptions are approved by an engineer or architect licensed by the state to practice. Wall or roof load present above any opening shall be carried, or transferred, to the bales below by one of the following:

(1) A frame, such as a structural window or door frame.

(2) A lintel (such as an angle-iron cradle, wooden beam, or wooden box beam). Lintels shall be at least twice as long as the opening is wide and extend a minimum of 24 inches beyond either side of the opening. Lintels shall be centered over openings.

(3) A roof plate designed to act as a rigid beam over the opening.

(*l*) (1) All weather-exposed bale walls shall be protected from water damage. However, nonbreathing moisture barriers shall not be used on the upper two-thirds of vertical exterior surfaces of bale walls in order to allow natural transpiration of moisture from the bales.

(2) Bale walls shall have special moisture protection provided at all window sills. Unless protected by a roof, the tops of walls shall also be protected. This moisture protection shall consist of a waterproof membrane, such

as asphalt-impregnated felt paper, polyethylene sheeting, or other acceptable moisture barrier, installed in a manner that will prevent water from entering the wall system at window sills or at the tops of walls.

(m) (1) Interior and exterior surfaces of bale walls shall be protected from mechanical damage, flame, animals, and prolonged exposure to water. Bale walls adjacent to bath and shower enclosures shall be protected by a moisture barrier.

(2) Cement stucco shall be reinforced with galvanized woven wire stucco netting or an acceptable equivalent. The reinforcement shall be secured by attachment through the wall at a maximum spacing of 24 inches horizontally and 16 inches vertically.

(3) Where bales abut other materials, the plaster or stucco shall be reinforced with galvanized expanded metal lath, or an acceptable equivalent, extending a minimum of six inches onto the bales.

(4) Earthen and lime-based plasters may be applied directly onto bale walls without reinforcement, except where applied over materials other than straw.

(n) (1) All wiring within or on bale walls shall meet all provisions of the 1993 National Electrical Code. Type ''NM'' or ''UF'' cable may be used, or wiring may be run in metallic or nonmetallic conduit systems.

(2) Electrical boxes shall be securely attached to wooden stakes driven a minimum of 12 inches into the bales, or an acceptable equivalent.

(o) Water or gas pipes within bale walls shall be encased in a continuous pipe sleeve to prevent leakage within the wall. Where pipes are mounted on bale walls, they shall be isolated from the bales by a moisture barrier.

SEC. 2. Notwithstanding Section 17610 of the Government Code, if the Commission on State Mandates determines that this act contains costs mandated by the state, reimbursement to local agencies and school districts for those costs shall be made pursuant to Part 7 (commencing with Section 17500) of Division 4 of Title 2 of the Government Code. If the statewide cost of the claim for reimbursement does not exceed one million

dollars ($1,000,000), reimbursement shall be made from the State Mandates Claims Fund.

Notwithstanding Section 17580 of the Government Code, unless otherwise specified, the provisions of this act shall become operative on the same date that the act takes effect pursuant to the California Constitution.

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