Appendix BJ: Strawbale Construction

July 15, 2025

GOALS
FOSTER A DIALOGUE
AGREE ON A MINIMUM STANDARD FOR MN

AGENDA

REASONS FOR ADOPTION

SYSTEMS OVERVIEW

PROPOSED AMENDMENTS

RESPONSES TO TAG MTG 1

DISCUSSION

REP. KATIE JONES
MN House Representative, District 61A
Strawbale Homeowner

SIMONA FISCHER, AIA
Director of Sustainable Practice
MSR Design

MN IRC CODE CHANGE PROPOSAL PRESENTATION

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TUESDAY 15 JULY 2025

PRESENTERS:
MN House Representative Katie Jones
Simona Fischer, AIA

REASONS FOR CODE ADOPTION

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- Strawbale buildings are being constructed in MN because they are durable, safe, high performing, and healthy when built to appropriate minimum standards.
- Adoption of Appendix BJ would provide a consistent statewide minimum standard
- Appendix BJ is robust, building upon and referencing the body of the residential code
- Proposal includes Amendments based on additional cold/wet-hot/humid climate research from Canada (Ontario), Vermont, and Upper Midwest

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MATERIAL

Appendix BJ requires the use of straw,
and prohibits hay

Appendix BJ contains bale density and moisture content requirements

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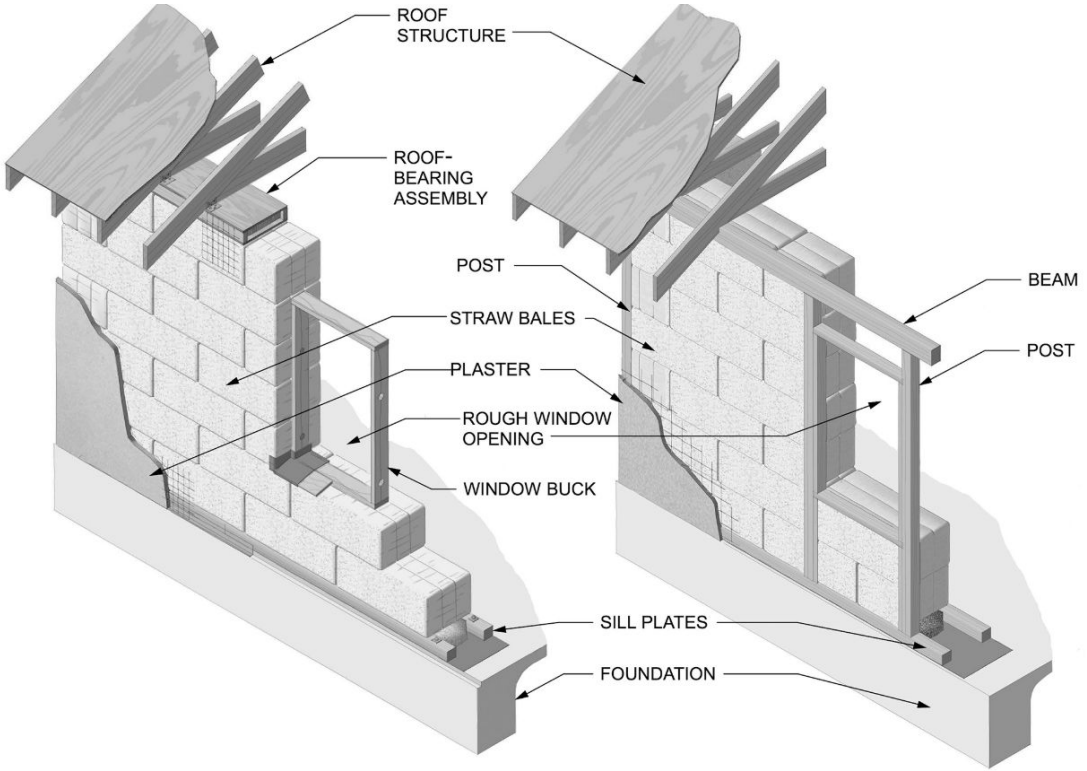
A: LOAD BEARING **B: POST-AND-BEAM with STRAW BALE INFILL**



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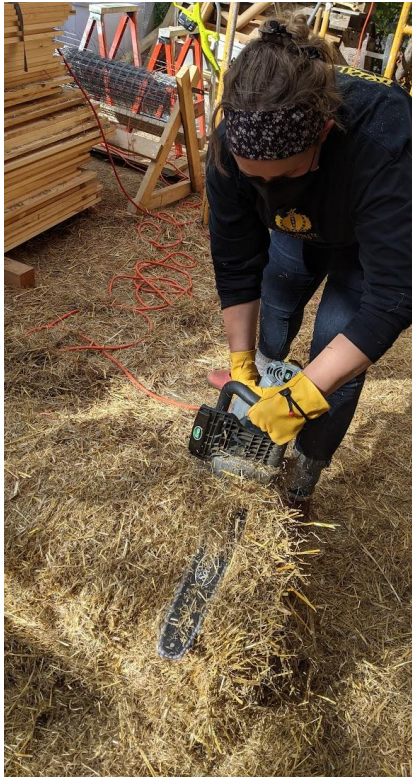
STRUCTURAL SYSTEMS

Appendix BJ allows:

- load-bearing SB walls
- post-and-beam with SB infill
- limited to 1-story, or 2-story with an engineered design

Process of stacking bales into the post-and-beam 2-story structure

SYSTEMS OVERVIEW



Notching the straw bales

Installing wire mesh

Wire mesh and lateral ‘x’ bracing at posts

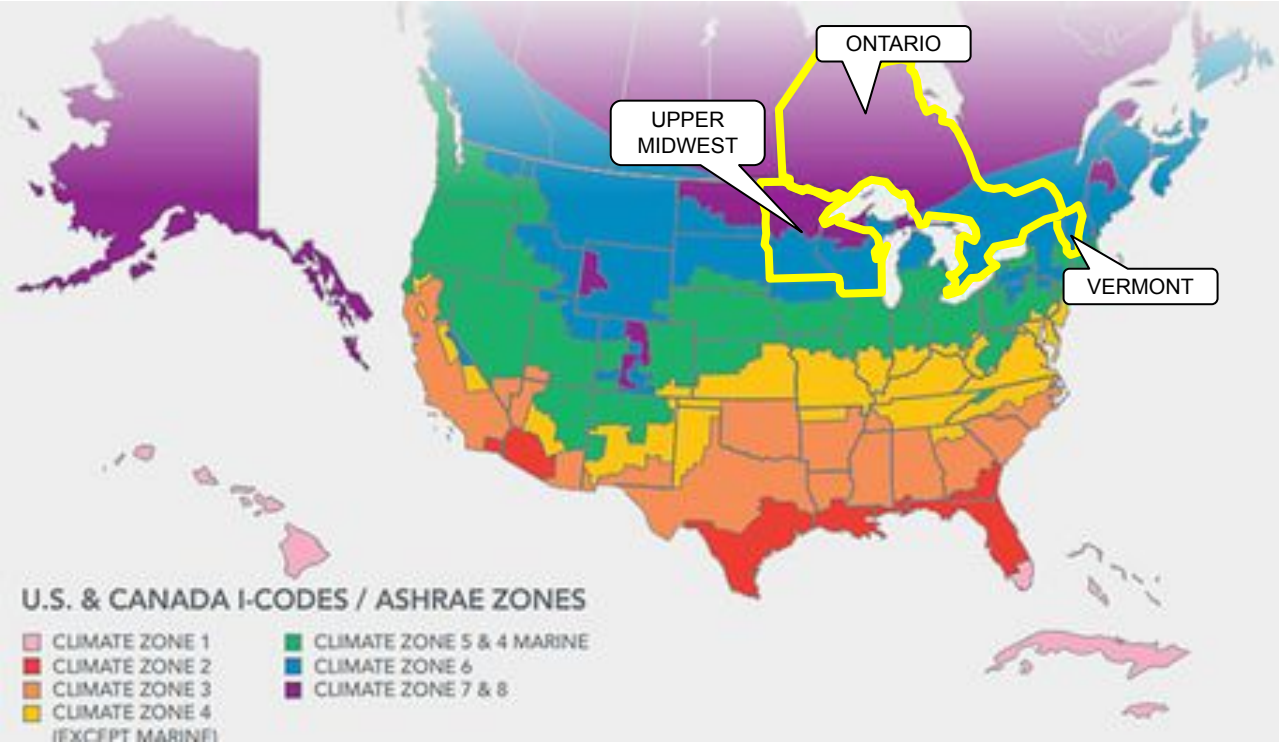
SYSTEMS OVERVIEW

Exterior view of strawbale infill

Flashing, trim, and plaster scratch coat

COLD CLIMATE FOCUS

How many strawbale buildings have had issues related to moisture and fire?



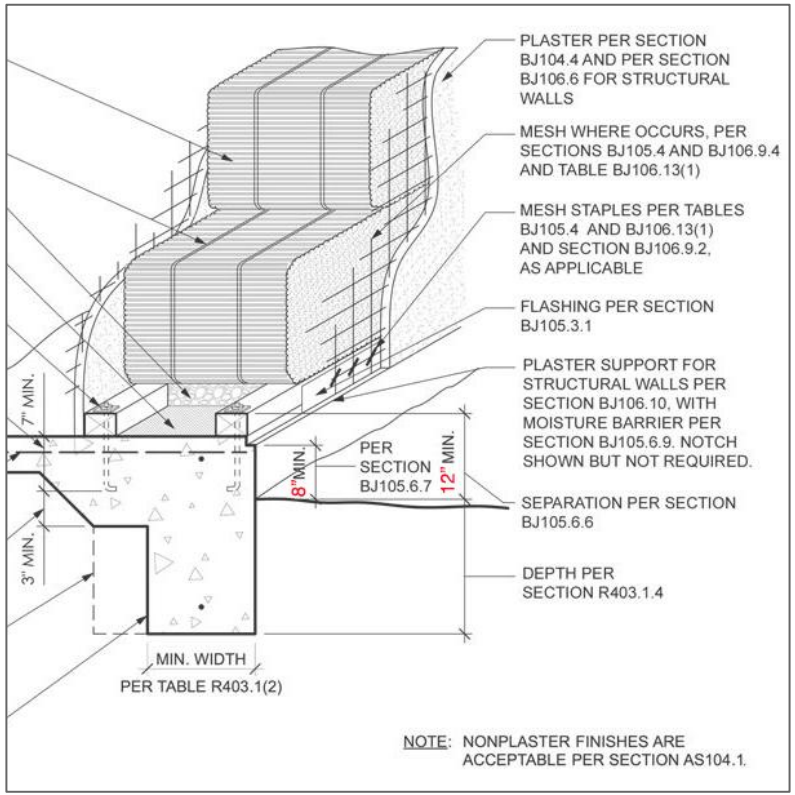
5 STRAWBALE EXPERTS WORKING IN CAN, VT, MN, and WI

REPORTED ON 100+ STRAWBALE BUILDINGS IN CLIMATE ZONE 6 & 7:

- **FEW MOISTURE ISSUES**
- **NO FIRE ISSUES**

PROPOSED AMENDMENTS

FIGURE BJ105.1(1)—TYPICAL BASE OF PLASTERED STRAWBALE WALL ON CONCRETE SLAB AND FOOTING

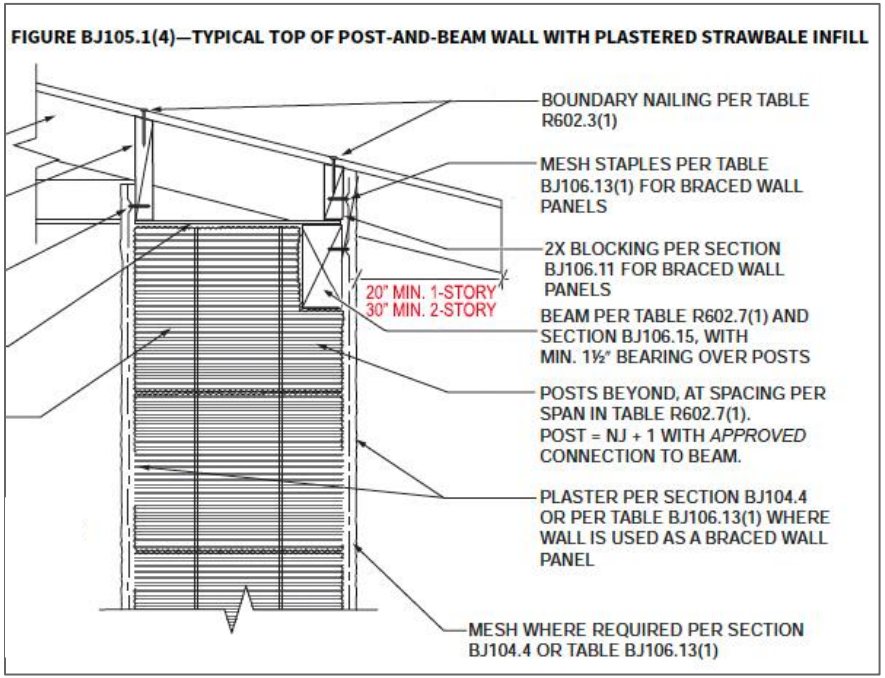


BJ105.6.6 Separation of bales and earth. Bales shall be separated from earth by not less than ~~8~~ 12 inches (~~203~~ 305 mm) in accordance with Figure BJ105.1(1).

BJ105.6.7 Separation of exterior plaster and earth. Exterior plaster applied to straw bales shall be located not less than ~~6~~ 8 inches (~~152~~ 203mm) above earth or ~~3 inches (76 152 mm) above~~ paved areas in accordance with Figures BJ105.1(1) and BJ105.1(2).

- Increase separation of strawbale walls above grade and paving, greater than the minimum currently in Appendix BJ and for conventional wood-framed walls

PROPOSED AMENDMENTS



BJ105.6.10 Roof overhangs. Strawbale walls with direct-applied exterior plaster shall be provided with roof overhangs as follows:

1. 20” (508 mm) horizontal projection for one-story buildings
2. 30” (762 mm) horizontal projection for two-story buildings

Exception: Exterior strawbale walls with ventilated cladding in accordance with BJ104.1.1.

- Increased weather protection for strawbale walls, beyond conventional wood-framed walls which have no roof overhang requirement in the code
- Increases by 25% the recommended minimums of 16” and 24” provided by strawbale researcher John Straube / University of Waterloo in Ontario

PROPOSED AMENDMENTS

Roll, brush, or spray-applied silicate mineral paint

BJ105.6.1.1 Exterior plaster and silicate mineral paint. An *approved* silicate mineral paint shall be applied to exterior plasters that are direct-applied over strawbale walls.

- Common and standard practice in Ontario when using direct-applied exterior plaster
- Silicate mineral paints chemically bond with the mineral substrate they are applied to, creating a durable, water-repellent, and vapor-permeable surface
- Significantly reduces water absorption by the plaster, thereby preventing the formation of cracks due to freeze-thaw cycles
- Included in revised CCP (blue highlight)

RESPONSES TO TAG MTG 1

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The following items were addressed in the code change proposal:

- **Bale density and moisture content**
- **Use of plaster exterior finish**
- **Moisture height above grade**
- **Post-and-beam structure**
- **Fire**

RESPONSES TO TAG MTG 1

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TAG Concern: Bale density and moisture content

1. **Bale density and moisture content need periodic special inspections, which are not indicated in Appendix BJ. The building official can't be expected to be on-site during construction to periodically test 5% of the bales.**

- Periodic special inspections are not required or needed. Only that density and moisture content be established, and that "the moisture content of the bales at the time of application of the first coat of plaster or the installation of another finish shall not exceed 20 percent . . ."

- Appendix BJ gives building officials authority and flexibility for verification of bale density and moisture content. Guidance is given in the Commentary. Building departments typically have and use the Commentary to interpret code provisions.

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TAG Concern: Use of plaster exterior finish

1. **Exterior plaster cracking and bulk water intrusion**
2. **Rain screens**
3. **Membrane layer**

- Concerns about plaster cracking and potential wetting and drying issues are addressed in Section **BJ104.4 Plaster**. For example, use of multiple coats, or single coat soil-cement plaster with required mesh, reduces cracking
- Roof overhang and silicate mineral paint amendments provide further protection in Minnesota's climate
- Rainscreens can be installed in accordance with **Section BJ104.1.1, Item 1**
- **BJ104.4.1** prohibits membranes between straw and direct-applied plaster to allow a bond with the straw and to facilitate transpiration of moisture from the bales. Decades of successful performance for thousands of buildings in every US and Canadian climate is a testament to this practice. (Building science of why this works in the John Straube paper provided)

RESPONSES TO TAG MTG 1

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TAG Concern: Moisture and height above grade

1. **Provide sufficient height and flashing of the stem wall of strawbale walls to ensure durability of the bales relative to Minnesota snow accumulation and safe discharge of any water that enters the wall system.**

- Stem wall found to be excessive as a minimum requirement, but amendment increases separation above grade for bales and plaster

- Flashing at bottom of wall (BJ105.3.1) and a WRB at horizontal surfaces (BJ105.6.4) are required. Flashing at window and door openings is same a required in the body of the code.

- Snow against strawbale walls is initially frozen with no moisture intrusion. Heat from building melts snow in contact with plaster creating an air space between snow and the wall. Silicate mineral paint amendment further limits moisture intrusion.

- Roof overhang amendment for walls with direct applied plaster finishes to provide additional protection

RESPONSES TO TAG MTG 1

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TAG Concern: Post-and-beam structure

1. **The residential building code does not include post-and-beam construction, thus requires professional engineering. Post-and-beam is commonly used for strawbale construction and the appendix does not address this.**
2. **In Minnesota, the snow load is greater than the load of another floor.**

- Appendix BJ Section **BJ106.15 Post-and-beam with strawbale infill** references IRC Table R602.7(1) as a prescriptive ‘post-and-beam’ design for strawbale walls. Or an “*approved* engineered design” can be used for post-and-beam outside the limitations of Table R602.7(1).

- Table R602.7(1) includes ground snow loads up to 70 psf, which exceeds the largest design ground snow load in Minnesota.

- Prescriptive path refers to IRC, or you can do an engineered design

RESPONSES TO TAG MTG 1

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TAG Concern: Fire

1. **Intact bale walls are very fire resistant, but if fire moves into the wall there is no fire blocking to stop fire from migrating in the wall.**
2. **Once started, how does the fire department not destroy the entire house trying to completely extinguish the fire?**
3. **Is there a risk of spontaneous combustion?**

- Stacked straw bales are very effective as continuous fire blocking
- Fire departments can locate smoldering fire in any wall, including bale wall, with their thermal imaging cameras
- No spontaneous combustion risk with straw. Only with large stacks of [wet] hay. Hay is prohibited in Appendix BJ Section **BJ103.7 Types of straw**
- Straw bales have tested well below the surface burning characteristic limits required for insulation, with an ASTM E84 test, achieving a Class A Rating.
- Appendix BJ includes 1- and 2-hour rated strawbale wall assemblies, and strawbale buildings have withstood recent wildfires where surrounding wood-framed buildings have been destroyed

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- **Adopting Appendix BJ ensures proper use and success of this building system. Amendments thoughtfully consider Minnesota's climate and are intended to make this robust in Minnesota**
- **Minnesota should make Appendix BJ *with Commentary* accessible to all users**
  - Appendix BJ provides enforceable language
  - Commentary provides intent and compliance examples