DEPARTMENT OF LABOR AND INDUSTRY

CODE CHANGE PROPOSAL FORM

(Must be submitted electronically)

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Date: 03/31/2025

Email address: jschaap@oertelarchitects.com

Model Code: 2024 IRC

Telephone number: 612-839-0039

Code or Rule Section: Appendix BJ

Firm/Association affiliation, if any: Oertel Architects

Topic of proposal: Strawbale Construction

Code or rule section to be changed: Appendices

Intended for Technical Advisory Group ("TAG"):

General Information	**Yes**	**No**
A. Is the proposed change unique to the State of Minnesota?	☐	☒
B. Is the proposed change required due to climatic conditions of Minnesota?	☐	☒
C. Will the proposed change encourage more uniform enforcement?	☒	☐
D. Will the proposed change remedy a problem?	☒	☐
E. Does the proposal delete a current Minnesota Rule, chapter amendment?	☐	☒
F. Would this proposed change be appropriate through the ICC code development process?	☐	☒

Proposed Language

1. The proposed code change is meant to:

☐ change language contained the model code book? If so, list section(s).

☐ change language contained in an existing amendment in Minnesota Rule? If so, list Rule part(s).

☐ delete language contained in the model code book? If so, list section(s).

☐ delete language contained in an existing amendment in Minnesota Rule? If so, list Rule part(s).

☒ add new language that is not found in the model code book or in Minnesota Rule.

Request that the State of Minnesota adopt the 2024 IRC Appendix BJ – Strawbale Construction into the Minnesota Building Code.

2. Is this proposed code change required by Minnesota Statute? If so, please provide the citation.
   No

3. Provide *specific* language you would like to see changed. Indicate proposed new words with underlining and ~~strikethrough~~ words proposed for deletion. Include the entire code (sub) section or rule subpart that contains your proposed changes.
   Full adoption of the 2024 IRC Appendix BJ Strawbale Construction
   https://codes.iccsafe.org/content/IRC2024P1/appendix-bj-strawbale-construction

4. Will this proposed code change impact other sections of a model code book or an amendment in Minnesota Rule? If so, please list the affected sections or rule parts.
   No

Need and Reason

1. Why is the proposed code change needed? Please provide a general explanation as well as a specific explanation for any changes to numerical values (heights, area, etc.)

Construction Method

Strawbale Construction has existed in North America since the late 1800's; a church in Nebraska constructed in 1928 and other strawbale buildings over 100 years old are still in service. Strawbale buildings have been constructed in every U.S. state - over a thousand in California alone - and in over 55 countries and in every climate worldwide. The *"classic and time-proven strawbale wall assembly consists of straw bales laid flat with a 1 to 1.5 inches (25 to 38 mm) thick metal mesh reinforced cement and/or lime stucco skin applied directly to each face* (John Straube, BSD-112)."

IRC Appendix BJ: Strawbale Construction is not currently adopted in MN. Despite this, there are a number of successful examples of strawbale construction in the state. Building owners may choose to construct strawbale walls for reasons including stability and strength, supporting a local MN economy and agriculture by building out of a prevalent agricultural by-product grown locally, [TAG said don't point to carbon sequestration] and superior energy performance compared with other code-approved building materials and systems. Strawbale wall assemblies designed and built in accordance with Appendix BJ are a viable construction methodology in all of MN's cold and very cold climates (ASHRAE Climate Zones 6A, 7 and also a small amount of 5).

IRC Appendix BJ (originally Appendix S) was approved by the ICC in 2013 and included in the 2015 IRC. The Appendix provides requirements for Strawbale Construction for both load-bearing and non-load bearing strawbale wall systems, in all climate zones. Structure, Durability, Moisture, Fire Resistance and Energy Performance are addressed in detail. Adopting Appendix BJ is important for the state of MN, to ensure strawbale buildings are properly designed and constructed, as well as to facilitate uniform code enforcement.

Please see BJ Addendum 1_2024_IRC_Comm_Appendix_BJ, for the full IRC Appendix BJ, including Commentary. The commentary provides additional insight as to the logic behind each section, especially with regard to moisture management and control in relevant sections.

Strength

Building Science Corporation's John Straube of Canada writes in article BSD-112 that strawbale walls behave *"in most respects like a sandwich panel system... The reinforced skins take almost all of the load since these are the stiffest and strongest materials in the system. The* strawbales *act as a substrate for the stucco and as effective insulation."* BSD-112 provides a concise-yet-thorough overview of strength, durability and moisture management (including wetting and drying) in strawbale wall systems, particularly in cold cli- mates, and is attached to this application as Addendum 2.

Structural integrity of strawbale walls is addressed in detail in Appendix BJ (Section BJ106), and is supported by Structure Magazine scholarly articles in Addendums 3-4 that follow this proposal.

Durability

Strawbale walls designed in accordance with Appendix BJ are durable, vapor open assemblies that control moisture by prevention of bulk water intrusion and through bi-directional drying. See Addendum 1 and Addendum 2 for prescriptive and technical reference information.

In a recent local example, the Uptown Strawhouse in Minneapolis, climate zone 6A (construction completion 2022), was embedded with moisture sensors that showed the moisture content in the bales well below the 20% maximum allowed by Appendix BJ to prevent damage and mold growth from excessive moisture. See Addendum 8 for Uptown Strawhouse moisture data.

Fire resistance of strawbale walls is equivalent or superior to many other code compliant wall options. Straw, and therefore strawbale walls *cannot* spontaneously combust. Under some circumstances agricultural stacks of *hay* have been known to spontaneously combust, but hay is prohibited from use in section BJ103.7 Types Of Straw . . . “Bales shall not be composed of hay.” Also, strawbale buildings designed in accordance with Appendix BJ have withstood large scale wildfires in California and other areas. See Addendums 5, 6 and 7 for fire testing and case studies.

Energy Performance

Strawbale walls offer energy performance that exceeds MN 2024 Energy Code, and surpasses that of many typical code-compliant construction methodologies. Appendix BJ Section 108.1 lists: "The unit R-value of a strawbale wall with bales laid flat is R-1.55 for each inch of bale thickness. The unit R-value of a strawbale wall with bales on-edge is R-1.85 for each inch of bale thickness." This means a wall using 2-string bales laid flat, typical width 18", will be R-27, conservatively. Because of a significant reduction in thermal bridges, strawbale walls are aligned with continuously-insulated assemblies, further improving efficiency and reducing potential issues related to condensation.

2. Why is the proposed code change a reasonable solution?

This is a reasonable solution because Appendix BJ has been approved through ICC's national model code development process to regluate strawbale construction as a viable and tested structural wall system and/or insulation infill material and substrate for plaster.

3. What other factors should the TAG consider?
   Strawbale construction is a durable solution for clients interested in creating safe, healthy, durable and energy-efficient homes that support a local economy.

Cost/Benefit Analysis

1. Will the proposed code change increase or decrease costs? Please explain and provide estimates if possible.

   There are not enough recent case studies in Minnesota to determine an average cost of construction for strawbale wall systems yet. The strawbales themselves and plaster are far below the procurement cost of conventional building materials, but a lack of experience with the system and the time required to stack bales, install mesh, and plaster the bales properly will likely mean increased cost of labor for the strawbale walls only. That said, a benefit of strawbale wall systems is the ability for homeowners to complete this portion themselves. With MN's adoption of Appendix BJ, it is expected that strawbale walls become more widely used, and the cost of the design and construction of strawbale wall systems will come down as the market adjusts. Other elements of the building typically use conventional materials and methods, and without cost increase.

2. If there is an increased cost, will this cost be offset by a safety or other benefit? Please explain. If the benefit is quantifiable (for example energy savings), provide an estimate if possible.

   Potential increased cost for the design and construction of strawbale walls will be offset by increased energy performance (lower utility bills), and better indoor air quality. Using Minnesota-grown straw will also benefit local economies and create a new market for local farmers.

3. If there is a cost increase, who will bear the costs? This can include government units, businesses, and individuals.

   Residential owners and developers would bear the additional costs.

4. Are there any enforcement or compliance cost increases or decreases with the proposed code change? Please explain.

   No. The responsibility and cost for demonstrating compliance with requirements particular to Appendix BJ (such as bale density, maximum moisture content, and compressive strength for plaster) are borne by the homeowner or developer.

5. Will the cost of complying with the proposed code change in the first year after the rule takes effect exceed $25,000 for any one small business or small city (Minn. Stat. § 14.127)? A small business is any business that has less than 50 full-time employees. A small city is any statutory or home rule charter city that has less than ten full-time employees. Please explain.

   No

Regulatory Analysis

1. What parties or segments of industry are affected by this proposed code change?

Insulation contractors and framers may need to adjust their methodology to allow for the increased thickness of strawbale walls.

2. Can you think of other means or methods to achieve the purpose of the proposed code change? What might someone opposed to this code change suggest instead? Please explain what the alternatives are and why your proposed change is the preferred method or means to achieve the desired result.

None. Strawbale construction, properly regulated by Appendix BJ, has a unique combination of attributes that no other wall system possesses, as described previously in this application. It would supplement Minnesota's current Residential Code, providing a highly energy efficient wall system option for Minnesotans.

3. What are the probable costs or consequences of not adopting the code change, including those costs or consequences borne by identifiable categories of affected parties, such as separate classes of government units, businesses, or individuals?

Energy-efficient, locally-beneficial, sustainable building such as strawbale construction is growing in popularity. Without adoption of Appendix BJ, a patchwork of code enforcement is likely, adding cost and complexity to the design, plan check, permitting, construction and inspection processes. In addition, this could cause rogue builders and homeowners to construct unpermitted strawbale buildings and build unsafe and unhealthy homes. By adopting Appendix BJ, code officials will have the proper tools to evaluate strawbale building design and construction and ensure safe and durable strawbale buildings.

4. Are you aware of any federal or state regulation or requirement related to this proposed code change? If so, please list the federal or state regulation or requirement and your assessment of any differences between the proposed code change and the federal regulation or requirement.

Yes. Appendix BJ in the national model 2024 IRC, clearly defines the use of strawbale walls in residential construction and their proper design and construction.

***Note: The information you provide in this code change proposal form is considered Public Data and used by the TAG to consider your proposed modification to the code. Any code change proposal form submitted to DLI may be reviewed at public TAG meetings and used by department staff and the Office of Administrative Hearings to justify the need and reasonableness of any proposed rule draft subject to administrative review and is available to the public.

****Note: Incomplete forms will be returned to the submitter with instruction to complete the form. Only completed forms will be accepted and considered by the TAG. The submitter may be asked to provide additional information in support of the proposed code change.

MN IRC Code Change Proposal: Appendix BJ_Strawbale Construction

Local Impact Statements

3/31/2025

Anna Koosmann AIA, CPHC

Senior Architect & Certified Phius Passive House Consultant

AWH Architects

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Minneapolis, MN 55409

Statement from Anna Koosmann:

As a Senior Architect and Certified Phius Passive House Consultant, I strongly advocate for the adoption of Appendix BL (Hemplime/Hempcrete) and Appendix BJ (Straw Bale) into the Minnesota IRC Building Code for this next cycle. Integrating these appendices is essential to ensuring quality performance, standardizing best practices, and advancing sustainable building methods that are increasingly in demand.

The construction industry is experiencing a growing shift toward natural building materials that support energy efficiency, carbon sequestration, and occupant health. By formally adopting these appendices, we can:

- **Standardize Building Assemblies & Best Practices** – Establishing clear, tested guidelines will ensure consistent, high-performance construction and reduce variability in execution.
- **Streamline the Permit Review Process** – Standardized requirements will help reduce delays and confusion, leading to time and cost savings for building departments, architects, contractors, and stakeholders.
- **Enhance Construction Quality** – Clear codes will minimize human error and ensure projects meet proven performance standards.
- **Meet Industry Demand** – Clients are increasingly requesting hempcrete and straw bale assemblies, making this the ideal time to establish clear regulatory standards.

Without adopting these appendices, we risk inconsistent construction practices, extended review times, and inefficiencies due to the lack of established guidelines. The construction industry has a responsibility to adapt to evolving materials and performance standards, ensuring that buildings are durable, high-performing, and built to last in Minnesota's climate.

Now is the time to act. Adopting these appendices will benefit the entire industry and set a precedent for future advancements in sustainable building practices.

Local Impact Statement

Adoption of the strawbale and hemp-lime building code appendices will allow for more straightforward approval of buildings featuring these types of construction. Streamlining the approval process will save these projects considerable amounts of money and time that would otherwise be spent on additional engineering assessments, documentation, and related discussions. This is not only beneficial for the project owners and development teams, but also for the busy code officials and code departments that will be reviewing them.

From a building science and durability standpoint, adoption of these code appendices will provide a much needed resource for these relatively unknown building systems. It is fair to say that most building professionals are unfamiliar with the materials construction issues addressed in the appendices. The code language will provide clear direction on the most salient construction and design issues, helping to ensure that both design teams and code review teams are addressing critical items, and ultimately ensuring the durability and safety of these buildings.

Finally, our climate in MN is changing rapidly. Building assemblies with strong warm-side vapor retarders could begin to pose summertime condensation risks – just as they already do in more southerly climate zones. Strawbale and hemp-lime construction are designed with a more even, symmetric and open vapor profile that – when combined with some safe moisture storage – should offer a safer and more durable approach to vapor management in the coming years.

Rolf Jacobson

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