

CEEn-2018CPST-003

ACUTE/UNTF NAVAJO HOUSE PLANS

B⁴ Engineering

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Introduction

- **The Nizhoni and Comb Ridge house plans designed for the Utah Navajo Trust Fund were analyzed to update the structural elements, in accordance with sound engineering practices.**

Project Tasks and Deliverables

- **Over the course of the last academic year, the following were completed:**
 - **Engineering was performed in accordance with the 2015 International Building Code.**
 - **Both the Nizhoni and Comb Ridge plans were reviewed and potential revisions were recommended.**
 - **Structural details were added to each plan as a means of simplifying construction.**
 - **A bill of materials was compiled for structural elements for each plan.**

Design and Analysis

- Design criteria for all chapter locations were determined in accordance with ASCE 7-10 and typical design practices of San Juan County, Utah.
- Worst-case design criteria were applied to all locations.
- Housing plans were analyzed using methodologies from the 2015 International Building Code (IBC) in accordance with the Utah Amendments to the IBC and the 2015 International Residential Code (IRC).
- Structural elements from both codes were compared with the call-outs from the original designs.

Discussion of Results

- **The IBC design was selected because of several factors:**
 - Shear wall specifications were cheaper and easier to construct than those specified in the IRC.
 - The IBC methodology specifies calculations to determine member sizes, whereas the IRC uses stricter prescriptive methods that do not allow for optimization.
 - The IBC takes more factors into account when sizing members that can allow for more accurate and economical design.
 - The resulting structural members are more sound than what was previously called out.

Discussion of Results Cont'd

Member	Original Call-Out	IBC Result
4' Header	(2) 2X6	(3) 2X6
5' Header	(3) 2X6	(3) 2X8
8' Header	(2) 2X10	(2) 1.75X9.5 LVL
Floor Beam	(2) 2X10	(3) 2X10
Anchor Bolt Spacing	24" O.C.	72" O.C.
Floor Joist	9.5" TJI @ 16" O.C.	2X10 @ 16" O.C.
Dowels to Slab	24" O.C.	None
Floor Nailing	8d @ 8" O.C. Field, 6" O.C. Edge	8d @ 12" O.C. Field, 6" O.C. Edge
Wall Nailing	Not Specified	8d @ 6" O.C.

Discussion of Results Cont'd

- **Improvements made to the plans:**
 - **Beams conform to accepted engineering practices.**
 - **Fewer anchor bolts are required.**
 - **2x10 floor joists will be much cheaper and more readily available than TJI joists.**
 - **Removing the dowels from the slab will reduce costs and prevent slab cracking.**
 - **Required nailing for the floor sheathing was reduced.**
 - **Required nailing for the wall sheathing was specified where it was not before.**
 - **Structural details and a bill of materials were included to facilitate rapid construction.**

Conclusions

- Revisions were suggested to make the plans more cost effective.
- Several members were optimized for structural performance.
- Structural details were included to speed up construction.
- A bill of materials was compiled for each plan to simplify materials sourcing.

Recommendations

- **We recommend that the IBC methodology be implemented on these housing plans.**
 - **The structural details and bill of materials were created using this methodology.**
- **A site-specific analysis could be performed to reduce some member sizes for several chapter locations.**
- **The 2018 IBC will be implemented beginning the summer of 2019 in Utah.**
 - **This edition will provide a more accurate snow load for all locations.**

The End

Any Questions?