Chapter 6 - Conclusions

The field study has provided an opportunity to determine the behaviour of wetted cross-laminated timber panels within a variety of wall assemblies, and to verify the behaviour of the hygrothermal models in these extreme cases.

The most important summary conclusions are:

- Elevated moisture contents which allow for future decay are not likely to be developed due to typical environmental exposure to moisture on a construction site.
- Low permeance materials such as polyethylene sheeting and other non-vapour permeable water resistive barriers cause lower drying potential, and are unnecessary for good wall assembly design. However, the field data shows these panels dried in sufficient time to prevent decay initiation.
- For panel locations above 15% moisture content, drying can slow during the winter, then pick-up again in summer.
- Further development of the hygrothermal model together with refined material properties are required to more accurately model wood.

One of the first insights to come out of this study came during construction, when it was observed that the unprotected, wetted panels dried very quickly under typical southern Ontario summer conditions. While for this field test, this behaviour made it difficult to capture the initial drying phase, it does indicate that during a typical construction project, where efforts are made to protect wood on construction sites, the highest possible initial moisture content at the time of enclosure of the CLT panels due to accidental moisture exposure can be low enough to reduce potential durability problems under normal operating conditions. However, more work is required to determine the extent to which on-site exposure can cause excessive moisture accumulation under a variety of climates, and with different wood species, exposure times, and CLT manufacturing methods. Overall, it seems unlikely that if reasonable measures are taken to protect cross laminated timber panels from wetting, construction moisture alone is not likely to be a cause of long term moisture durability issues.

In terms of suitable wall assemblies, the use of high permeance envelope materials can effectively promote drying of CLT panels.

The medium permeance wall configurations are sufficiently vapour permeable to prevent moisture durability issues under normal circumstances with initially dry panels, though further investigation may be needed to determine the cause of the moisture content increase in Panel C3.

Low permeance materials, especially to the exterior, are to be used with more caution, not only because they prolonged the time period required for wetted panels to dry to a safe level in some cases, but also because the lack of steep rise in the moisture content in the centre of the panel, further indicates that the CLT panel itself is a good vapour retarder. Therefore any additional vapour barrier is unnecessary in a CLT assembly. While in the test wall, both the interior and exterior low permeance wall panels dried sufficiently quickly to prevent decay initiation, the low permeance material may have a more deleterious effect if an incidental moisture source is present, enabling a rise of local moisture content over time.

Finally, the wood species does not appear to have a significant effect on the drying rate of the CLT panels, though it appears as though the plantation grown European spruce panels tend to reach slightly higher moisture contents when exposed to ongoing moisture sources.

6.1 Further WUFI Calibration

The WUFI model used appears to correlate sufficiently well with the field measurements at moisture contents below 25% to predict general trends in the moisture content of the CLT panels. This is the range at which the cross laminated timer is expected to be found when performing well. Further refinement of the model is required to more accurately predict hygrothermal behaviour at moisture contents where there is a serious risk of decay.

Above 25% moisture content WUFI both overestimates and underestimates the moisture content of the panels. Due to the extended period of time required for decay to initiate, this inaccuracy does not lead the user to believe that any panels which have field measurements at risk for decay are not at risk after 6 months. However, as the effect of wetting at the end grain of the CLT panels was not included in this field study, and moisture uptake and penetration is likely to be higher if the edges are wetted, refinement of the hygrothermal model, or usage of an two dimensional modelling program may be required to model these situations.

Further investigation may also be made into the cause of the tendency to predict less drying or even wetting in the centre of the panels which the field data does not indicate, as well as the low reactivity to external relative humidity. These anomalies may be resolved with a different set of material properties in the existing hygrothermal model, or with the use of an alternate hygrothermal model for wood.