RESEARCH REPORT

INVESTIGATING MOISTURE IN SEASONAL HOUSING

Canada

CMHC SCHL
HOME TO CANADIANS

CMHC—HOME TO CANADIANS

Canada Mortgage and Housing Corporation (CMHC) is Canada's national housing agency.

Backed by over half a century of experience, we work with community organizations, the private sector, non-profit agencies and all levels of government to help create innovative solutions to today's housing challenges, anticipate tomorrow's needs, and improve the quality of life for all Canadians.

CMHC assists Canadians in all parts of the country to access a wide range of innovative and affordable financing choices. Through research, we contribute to the well-being of the housing sector. Working with our provincial, territorial, non-governmental partners and the private sector to deliver the federal government's housing agenda, CMHC helps Canadians from all walks of life access quality, affordable homes. At home and abroad, we work in close collaboration with our government partners and the housing industry to enhance Canada's presence in the global marketplace, and share our housing experience and expertise with the world.

In everything we do, we're committed to helping Canadians access a wide choice of quality, affordable homes, while making vibrant, healthy communities and cities a reality across the country.

For more information, visit our website at www.cmhc.ca

You can also reach us by phone at 1 800 668-2642 or by fax at 1 800 245-9274.
Outside Canada call (613) 748-2003 or fax to (613) 748-2016.

Canada Mortgage and Housing Corporation supports the Government of Canada policy on access to information for people with disabilities. If you wish to obtain this publication in alternative formats, call 1 800 668-2642.

Abri Sustainable Design & Consulting

583 Indian Point Road, Glen Haven, NS Canada B3Z 2T5
phone +1.902.489.1014 • fax: +1.902.821.2112 • URL: www.abridesign.com

Investigating Moisture in Seasonal Housing

Final Report

15 November 2005

Abstract

This study was premised on the fact that moisture problems exist in seasonally occupied houses from some identifiable sources. The challenge was to work with low-cost solutions for a range of house conditions to combat high moisture levels. There was some success in mitigating moisture problems in the field study houses.

Executive Summary

This study was an initial investigation into the vexing problem of musty seasonal dwellings. This was not meant to be a scan of the *condition* of seasonally occupied housing; more it was based on the fact that moisture problems exist in these houses from some readily identifiable sources. The challenge was to work with what is already available to a range of house conditions to combat high moisture levels.

An on-line survey of seasonal houses and their general characteristics was carried out, then a number of houses in Nova Scotia were selected for field testing. The goal was to find inexpensive ways to reduce or eliminate the musty smell typical of seasonal houses.

The survey caught the interest of 50 homeowners, mainly in eastern Canada. Twelve Nova Scotian entries were enlisted to be part of the field study, but only ten ended up participating in the field study, which consisted of an EnerGuide for Houses evaluation and an indoor air quality evaluation carried out by a CMHC-trained technologist. Six homeowners carried out most or all of the recommendations made by the project team. Five houses were monitored over the course of two years.[1] There was some success in mitigating moisture problems in the field study houses, but there is not much proof of the success, because datalogger failure resulted in an incomplete sample. Foundation problems were the major moisture issues found in the field study houses. In most cases, mitigating foundation moisture problems seemed to reduce the overall RH levels in the houses that were monitored. Anecdotally, the houses that were not monitored also have experienced an increase in air quality and a decrease in condensation; moisture and/or mold growth problems once the recommendations made by the project team were carried out. The recommendations made were all recognized solutions to 'standard' foundation moisture issues.

[1] The houses were left 'as is' for the first monitoring period (November 2003 through April 2004), with recommended changes being made in the summer of 2004. The second monitoring period (November 2004 through April 2005) was to indicate any changes in the behaviour of the houses.

The fact that all houses in the field study had moisture problems emanating from the foundation is a clear indication that seasonal homeowners could improve the indoor air quality and the lifespan of the buildings by attending to same. Repairing the damage done by moisture problems left unchecked can be more costly by far than dealing with the moisture problem itself.

Homeowners were reluctant to carry out recommendations that seemed unusual or costly. In this study, homeowners were unwilling to pay more than $200 for all improvements. The owner of one house put more than $200 towards the recommendations, but the mold problem in that house was so severe that they were unable to use the house as it was.

The project team had hoped to be able to produce and monitor a series of details and recommendations for mitigating moisture problems in seasonal homes. Some of the proposed ideas included a solar chimney to pull sun-heated air out, fan-powered crawlspace venting and humidistat controls on existing bathroom fans. However, homeowners (including rental cottage owners) were not willing to pay for power over the winter. One homeowner did install a crawlspace ventilation system, but will only operate the ventilation system when the building is in use.

Findings

For the most part, key diurnal temperature patterns appear in November and from March on. These diurnal swings – highs above 10°C and lows approaching 0°C – are important in that they could lead to house interiors reaching saturation or dew point temperatures frequently over these months, especially in wet fall or spring conditions when RH levels are already high. March is noted as a month where this situation could occur on a daily basis, at least in Nova Scotia. April is, on the whole, warmer than March, without the below-zero overnight/early morning temperatures, and there is a general trend to slightly lower RH levels.

It would seem that one or more inexpensive options could be used to reduce humidity levels and ‘saturation events’, thereby reducing or even possibly eliminating musty smells, condensation and mold issues. Certainly dealing with moisture issues arising from physical defects such as foundation problems, poor drainage and lack of eavestroughing would go a long way to improve indoor air quality in seasonally occupied housing.

Résumé

La présente étude consistait au départ à aborder le fâcheux problème des logements secondaires dégageant une odeur de moisi. Elle n'était pas destinée à évaluer l'*état* des logements occupés de façon saisonnière; elle était davantage fondée sur le fait que les problèmes de moisissure qui existent dans ces logements ont une origine facilement caractérisable. Le défi était de composer avec ce qui existe déjà pour toute une gamme de conditions d'habitation en vue d'y éliminer le degré élevé d'humidité.

Une enquête en ligne portant sur les maisons secondaires et leurs caractéristiques générales a été effectuée, puis un certain nombre de maisons de la Nouvelle-Écosse ont été choisies pour fins d'essai sur place. L'objectif consistait à trouver des moyens peu coûteux d'atténuer, voire d'éliminer, l'odeur de moisi typique des maisons secondaires.

L'enquête a attiré l'attention de 50 propriétaires-occupants, surtout de l'est du Canada. Douze bâtiments de la Nouvelle-Écosse Twelve ont été inscrits à l'étude sur place, mais seulement dix ont fini par être soumis à l'étude, qui comportait une évaluation ÉnerGuide pour les maisons et une évaluation de la qualité de l'air intérieur effectuée par un technologue formé par la SCHL. Six propriétaires-occupants ont donné suite à la plupart, sinon à la totalité, des recommandations faites par l'équipe du projet. Cinq maisons ont fait l'objet d'un contrôle sur une période de deux ans[2]. On a quelque peu réussi à atténuer les problèmes d'humidité dans les maisons à l'étude, sans obtenir de véritable preuve, puisque la défaillance de l'enregistreur de données n'a pas permis d'obtenir un échantillon complet. Les principaux problèmes d'humidité touchaient les fondations des maisons à l'étude. Dans la plupart des cas, l'atténuation des problèmes d'humidité des fondations semblait réduire le degré d'humidité relative de toute la maison soumise au contrôle. Fait anecdotique, les maisons qui n'ont pas été soumises au contrôle ont également enregistré une augmentation de la qualité de l'air et une diminution de la condensation, des problèmes d'humidité et/ou de croissance de moisissure après avoir donné suite aux recommandations formulées par l'équipe du projet. Les recommandations constituaient toutes des solutions reconnues à des problèmes « standards » d'humidité des fondations.

Le fait que toutes les maisons à l'étude connaissaient des problèmes d'humidité provenant des fondations indique clairement que les propriétaires des maisons secondaires peuvent améliorer la qualité de l'air intérieur et la durée de leur bâtiment en donnant suite aux mêmes

[2] Les maisons ont été laissées telles quelles pour la première période de contrôle (de novembre 2003 jusqu'en avril 2004 inclusivement), les changements recommandés étant effectués à l'été de 2004. La seconde période de contrôle (de novembre 2004 jusqu'en avril 2005 inclusivement) servait à indiquer tous les changements de comportement des maisons.

recommandations. Corriger la situation après avoir laissé l'humidité accomplir ses méfaits risque de s'avérer beaucoup plus coûteux que de composer avec le problème d'humidité proprement dit.

Les propriétaires ont hésité à donner suite aux recommandations qui semblaient inhabituelles ou coûteuses. Dans le cadre de la présente étude, ils refusaient de débourser plus de 200 $ pour tous les travaux d'amélioration. Le propriétaire d'une maison a consacré plus de 200 $ à la mise en oeuvre des recommandations, mais le problème de moisissure était tellement grave que le ménage ne pouvait pas habiter dans la maison telle quelle.

L'équipe du projet avait espéré être en mesure de produire et de contrôler une série de détails d'exécution et de recommandations visant à atténuer les problèmes de moisissure dans les maisons secondaires. Certaines idées proposées faisaient état d'utiliser une cheminée solaire pour extraire l'air chauffé par le soleil, un ventilateur mécanique dans le vide sanitaire, et de relier à un humidistat le ventilateur de la salle de bains. Par contre, les propriétaires (y compris les propriétaires de chalets locatifs) n'étaient pas disposés à acquitter les frais d'électricité pendant l'hiver. Un propriétaire a même installé un système de ventilation dans le vide sanitaire, mais ne le fait fonctionner le système de ventilation que lorsque le bâtiment est occupé.

Résultats

En grande partie, les profils clés des températures le jour se manifestent en novembre et à partir du mois de mars. Les fluctuations de température le jour, soit des maximums au-dessus de 10 °C et des minimums voisinant 0 °C, importent dans le sens où elles pourraient amener fréquemment l'intérieur de la maison au point de saturation ou à la température du point de rosée pendant ces mois, surtout par temps automnal pluvieux ou au printemps où le degré d'humidité relative est déjà élevé. On fait remarquer que mars est un mois où cette situation pourrait se produire quotidiennement, du moins en Nouvelle-Écosse. Avril est, dans l'ensemble, plus chaud que mars, sans que la température la nuit ou le matin descende sous le point de congélation, et il enregistre généralement un degré d'humidité relative légèrement plus faible.

Il semblerait qu'une ou plusieurs options peu coûteuses pourraient servir à réduire le degré d'humidité et les occasions de saturation, réduisant ou éliminant les odeurs de moisi, de même que les problèmes de condensation et de moisissure. Régler les problèmes d'humidité découlant de défauts des fondations, du piètre drainage et de l'absence de gouttières contribuerait grandement à améliorer la qualité de l'air intérieur des maisons secondaires.

CMHC SCHL

National Office
700 Montreal Road
Ottawa ON K1A 0P7
Telephone: (613) 748-2000

Bureau national
700 chemin de Montréal
Ottawa ON K1A 0P7
Téléphone : (613) 748-2000

Puisqu'on prévoit une demande restreinte pour ce document de recherche, seul le résumé a été traduit.

La SCHL fera traduire le document si la demande le justifie.

Pour nous aider à déterminer si la demande justifie que ce rapport soit traduit en français, veuillez remplir la partie ci-dessous et la retourner à l'adresse suivante :

Centre canadien de documentation sur l'habitation
Société canadienne d'hypothèques et de logement
700, chemin Montréal, bureau C1-200
Ottawa (Ontario)
K1A 0P7

Titre du rapport: _____

_____

Je préférerais que ce rapport soit disponible en français.

NOM _____

ADRESSE_____
rue App.

_____
ville province Code postal

No de téléphone ( ) _____

Table of Contents

Introduction

Seasonally occupied houses can suffer surface and/or structural damage due to moisture problems during those periods when there are no occupants. How do these moisture problems occur and what are some practical ways to prevent them? This two-year study was sponsored by CMHC to investigate the probable sources of moisture in seasonal housing and to field test some possible solutions to the problems arising. The consultants felt that it was imperative that these solutions be low-cost and easily replicated to ensure that the maximum number of householders will be able to take advantage of the findings of the study.

Where moisture sources are open crawlspaces and dirt floors under foundations of various sorts in seasonally occupied houses, the solutions are straightforward building envelope issues. The solutions to these gross water/moisture sources are better assembly details. Where more insidious moisture sources are the problem, or where moisture problems continue to occur, the project team looked at options such as selective shading, antimicrobial coatings, intermittent ventilation and other solutions.

The work on this project took place in Mainland Nova Scotia. The sources of moisture problems, and the extent of those problems, vary across the country. However, a large amount of study on moisture in housing has taken place in the Maritimes primarily because moisture problems are endemic to the built environment in this region. As a result, a large proportion of the related expertise resides here.

Seasonally occupied houses are common in both the coastal and inland areas of the Maritimes. The range of ages and structural conditions is vast, with good opportunity to see how theoretical solutions work in various applications. Housing in the Maritimes experience many structural and indoor air quality problems that stem from moisture issues due to climatic conditions. High humidity in summer, followed by a long shoulder season and a cold winter with several freeze-thaw cycles leading to a typical mild and wet spring leave the area with year-round dampness and significant seasonal flooding and runoff issues.

Background

Almost any Canadian who has rented or stayed in a cottage over the summer can wax poetic about the sensory experience of cottage life. If pressed, a good number of those Canadians could give a fairly accurate description of the welcoming musty smell upon opening the cottage at the first of the season. That first 'sniff' test invariably leads to 'airing out' – opening all windows and doors, possibly washing moldy surfaces down…the telltale signs of the presence of moisture problems are part of our national summer heritage. However poetical and nostalgic these signs may feel, they can be detrimental to both the health of the building and the health of occupants. Not only do rough summer cottages suffer from moisture problems, but other seasonally occupied buildings do as well. Moisture problems are caused by several factors in a 'closed' building.

For the most part, building science and housing research have focused on alleviating and eliminating moisture problems in buildings with year-round occupant loads. In Canada, the sources of moisture in year-round homes is a result of high humidity levels generated by occupant cooking, washing and bathing as well as respiration throughout the shoulder seasons and the heating season when the doors and windows are closed. Measures to alleviate and eliminate moisture loads (which are heightened by energy efficiency measures in new housing) have led to mechanical ventilation requirements being included in the National Building Code, and the recognition that some moisture problems in older housing can be dealt with through improved mechanical ventilation.

Seasonally occupied homes have moisture problems too, during the shoulder and heating seasons. However, in these homes the occupant loads – those that could be assumed to be the sources of most moisture generation when the house is closed up – are missing. What, then, are the causes of moisture problems when the occupants are not living in these buildings? Here are some possible answers to that question:

- Seasonally occupied houses are often located close to surface water such as: lakes, rivers, or oceans, putting them in proximity to seasonally high water tables and flooding during times when the buildings are closed up.

- Seasonally occupied houses are also often located in or close by forests, reducing the drying effects of winds and solar radiation.

- Seasonally occupied houses are not necessarily built to the high standards of year-round residences and are not generally kept up as well as year-round homes, allowing moisture (vapour and/or liquid) inside the envelope through poorly maintained eavestroughs, roofs or windowsills. In addition, small animals tend to take up residence when the humans move out, possibly resulting in future weather penetration or

exposure of the envelope to moisture infiltration. Nest-building and concurrent alimentary tract elimination add to that good old musty smell in the spring.

- Structurally, seasonally occupied houses are often built on less-expensive foundation systems. Open crawlspaces, dirt floors in shallow basements, concrete block construction all lead to water infiltration through various mechanisms: large leaks, capillary action, and seasonal high water tables. This, in combination with the proximity of many seasonal dwellings to water leads to high risk of water infiltration. Efflorescence, salt and water staining on foundation assemblies confirm the presence of seasonal water. As the interior and exterior temperatures fluctuate, this water evaporates and results in higher moisture content in the air, which in turn can lead to condensation on surfaces when the temperatures fall and the air cannot hold the same amount of moisture (witnessed in unheated workshops where table saws and other steel surfaces rust).

- Building assemblies can be the source of moisture penetration and rot, especially at the junction between concrete foundation or stem walls and the sill plates of wood frame walls. The absence of a sill gasket causes visible rot and deterioration within a few years of construction. This has been documented in new garages.[3]

- Physically, many seasonally occupied houses often have large expanses of glass to the view side (s) of the building. While they function well in the warm months to keep out rain and bugs, in the shoulder and heating seasons, they act as solar cookers for the building (except those facing north). Unshaded windows can cause temperature fluctuations within the building that are beyond the capacity of the air to hold moisture that condenses onto colder surfaces.

- The content of seasonally occupied houses can add to the impact of moisture problems. Moisture is wicked from damp surfaces and absorbed through condensation by cardboard and other boxes, upholstered furniture, draperies, books, mattresses and other household goods that remain in the building. It is quite possible that these household goods store and release moisture throughout the unoccupied seasons.

[3] Field experience of Terry Watters.

Project Objectives

The study was not meant to be a scan of the *condition* of seasonally occupied housing; more it was based on the fact that moisture problems exist in these houses from some readily identifiable sources. The challenge was to work with what is already available to a range of house conditions to combat high moisture levels. The range of conditions met by the houses in this study included:

- No external power/power shut off during periods of non-occupancy
- Electric power but no heating or cooling options[4]
- Possibility of heating, cooling and/or dehumidification options
- Periods of absence that last several seasons

There were four steps to this project:

1. Determine theoretical sources of moisture problems
2. Identify and investigate seasonally occupied houses for field study of moisture problems through a broadly promoted on-line survey
3. Determine theoretical solutions for a variety of moisture problem sources
4. Field test a selection of low-cost solutions

[4] Based on a Moisture Problem Assessment carried out by the NS Dept. of Natural Resources, in which the seasonally occupied building had a 'typical' heating option for deterring mold growth (i.e., electric baseboards set at 'low'), yet had considerable moisture and mold problems.

PART ONE:
SURVEY OF HOUSES

The survey was developed in paper format and also for on-line use. Of the total filled-out survey responses, (34), only one was a paper format. The consultants tried to reach a broad cross-section of seasonal homeowners and users from cottage and summer homeowners to commercial ventures such as B&Bs and rental cottage operations. The print version of the on-line survey can be found in the Appendices, section 8.

The consultants relied upon web contacts, paper mailouts, on-line , press releases and local radio show coverage as well as posters, handbills and word-of-mouth to promote the survey. Copies of the printed material can be found in the Appendices, section 9. Although many venues were pursued, there was no consistent method of tracking the survey responses except when individuals included the way in which they found out about the survey in their response. A table of promotional activities and the known number of calls or email inquiries resulting from each is included in the Appendices, section 9. An announcement of the survey and study was sent to over 120 on-line resources, including indoor air quality industry contacts, engineer and architecture associations across Canada, web and paper-based publications dedicated to the cottage lifestyle, cottage owner's associations, affiliations and other organizations, including insurance companies and real estate agents dealing in vacation properties. The response to this announcement and subsequent follow up communications were disappointing.

The most successful ways of getting the survey promoted (without having a rigorous tracking process in place to monitor the success of the promotions) were:

1. The second set of posters, which had the website URL listed at the bottom in tear-off strips
2. The handbills (based on poster design) left at hardware stores and other venues
3. "Maritime Noon", the regional CBC noontime show.

1 Survey Results

There were 34 survey responses with house data included. Fifty homeowners who expressed interest in the project, either through an email query or a phone query. Six responses are from Ontario, two responses are from New Brunswick, one is from Manitoba and the remaining 25 are from Nova Scotia.

In the following section, houses are identified with an individual code that is interpreted as follows:

The first two letters indicate the province in which the house is located (i.e., NS, NB, ON, MB).

The third letter indicates the type of cottage or house. For the purposes of the study, a cottage was defined as any building under 93m^2 (1000 S.F.).

A = UNINSULATED COTTAGE B = WEATHERIZED COTTAGE

C = UNINSULATED HOUSE D = WEATHERIZED HOUSE

The number following the province and type indicate the order in which each entry was added to the survey.

1.1 House Types and Foundations

The responses include 7 uninsulated cottages, 11 weatherized cottages, 4 uninsulated houses and 12 insulated houses. The age range of the buildings was from 1860 to 2000.

Overall, the survey sample included nine full basements (two of these were insulated), eight closed crawlspaces (two of these were insulated), six open crawlspaces, three shallow basements, two pole foundations and two slab-on-grade foundations. There were eleven poured concrete foundations, seven foundations each of concrete block and stone and five of wood (one of these was listed as pressure treated). A detailed table of house types and foundation characteristics can be found in the Appendices, Section 6.1.

1.1.1 UNINSULATED COTTAGES
(ONA70, NSA73, NSA81, NSA82, ONA84, NSA88, NSA99)[5]

Three of the seven uninsulated cottages have open crawlspace foundations, each with a different construction assembly: concrete block, PTW and stone. The one closed crawlspace was of poured concrete. One shallow concrete block basement was noted in Ontario (ONA70), as was a slab-on-grade foundation of wood – this is unlikely, and no further input from this homeowner was available. Only one of the foundations for the uninsulated cottages (also in Ontario, built in the 1930s) has a full basement, it is noted as being

[5] Boldface indicate houses that were monitored, an underline indicates houses that were included in the field study but not monitored

poured concrete with insulation. The age range for these cottages was 1930s to 1960s, with four being built between 1950 and 1969.

NSA81 was evaluated but not monitored.

1.1.2 WEATHERIZED COTTAGES

*(NSB76, **NSB78A**, **NSB78B**, NONB79, NSB83, NSB90, NSB93, NSB94, **NSB95**, NSB98, NSB101)*

Four of the eleven weatherized cottages are on closed crawlspaces. Two are poured concrete foundations, one is concrete block and one is stone. The poured concrete units are both insulated. Three of the eleven are on open crawlspaces (one is concrete blocks, one is wood and the third is poured concrete). One weatherized cottage sits on a pole foundation. One more has a poured concrete slab-on-grade foundation and two have full basements of poured concrete, all uninsulated. The age range for these cottages was between 1930 and 2000, with six being built before 1980.

NSB78B, ONB79 and NSB95 were evaluated and monitored before and after recommendations.

NSB98 and NSB101 were evaluated only.

1.1.3 UNINSULATED HOUSES

*(NONC69, ONC71, NSC91, **NSC96**)*

Of the four uninsulated houses included in the survey, three houses of these houses sit on stone foundations. All three of these are pre-1900 homes, with two in Ontario and one in Nova Scotia. The other uninsulated house is on a concrete block closed crawlspace and was built around 1940 in Nova Scotia.

NSC96 was included in the monitoring program.

1.1.4 WEATHERIZED HOUSES

*(**NSD68**, NSD72, OND74, NSD80, NSD85, NSD86, NSD87, NBD89, NSD92, NBD97, NSD100, MBD102)*

Two of the twelve weatherized houses have no reported information for the foundation. Of the remaining ten weatherized houses, one is on a pole foundation, one has a closed crawlspace of wood, one has a shallow poured concrete foundation, and five houses have full basements. Of the five full basements, two have stone foundations (both built in the 1860s in Nova Scotia), two have poured concrete foundations (one of these is insulated), and one has a concrete block foundation. The age range on these houses was the widest of all four categories: two houses are pre-1900, and the five others with age data downloaded were built in the 1960s or later.

NSD68 (pre-1900) was evaluated and monitored before and after recommendations.

NSD86 was evaluated but not monitored.

1.2 House Locations

The locations of the surveyed houses ranged from open seacoast to secluded forest. Proximity to open water also had a wide range, from less than 10 m to over 1km away. A detailed table of location information is found in the Appendices, Section 6.2.

1.3 Mold and Condensation

Mold and Condensation problems ranged from mild to severe in the study houses. Seven questions were asked in the survey. A detailed table of responses is included in the Appendices at Section 6.3. From the homeowners who filled out this section (all but three), the following information was garnered:

1.3.1 AIRING OUT

Seventeen houses are aired out at the beginning of the season. They range across the various types of houses and foundation types. Seven weatherized cottages and four weatherized houses were indicated.

1.3.2 MOLD IN HOUSE WHEN OPENED

Fourteen homeowners observed mold growth upon opening for the season. They range across the various types of houses and foundation types. Five weatherized cottages and four weatherized houses indicated.

1.3.3 MOLD IN HOUSE DURING SEASON(S) OF USE

Five homeowners observed mold in the house during the season(s) of use. None of the uninsulated cottages recorded mold growth when in use, whereas four weatherized buildings indicated yes.

1.3.4 MOLD CLEANED OUT OF HOUSE

Eighteen homes have had mold cleaned out of them.. The highest rate of mold cleaning – 13 of the eighteen – report was found in the weatherized buildings.

1.3.5 STANDING WATER OBSERVED/EVIDENCE OF WATER LEAKAGE INSIDE HOUSE

Ten homes have had standing water present in them (as observed by the homeowner). These ten, plus an additional fourteen homeowners report evidence of water leakage inside the dwelling.

1.3.6 CONDENSATION ON WINDOWS

Nineteen homeowners report problems with condensation on the windows. As noted below, water leakage was associated with fourteen of the houses reporting condensation on windows.

1.4 Discussion of Mold and Condensation Inputs

Nine of the thirty houses reporting mold and condensation problems answered 'yes' to five or more of the questions in this section. They are: **NSD68**, ONC69, **NS78A**, **NSB78B**, NSD86, NSD87, NBD89, **NSB95** and **NSC96**.[6] Of these nine, all indicated condensation problems on the windows as well as a mold cleaning and mold has been observed in all but one of them upon opening up for the season (NBD89). Only NSD87, NBD89 and **NSB95** have observed mold growth during the season of use.

Twelve of the houses that require airing out at the beginning of the season have had mold cleaned out of them, and eleven had condensation on the windows. The following seven houses had both mold cleaned out of them and condensation on the windows: **NSB78A**, **NSB78B**, ONB79, **NSB95**, NSD86, NSD89, NSD92 and NSB93.

Of the twenty-four reporting evidence of water leakage, thirteen also indicate problems with condensation on windows (ONC69, ONA70, NB76, **NB78A**, **NB78B**, NSD85, NSD86, NSD87, NBD89, NSD92, NSB93, **NSC96**, **and NSB101**). Four of these are weatherized buildings of varying ages. Six of these thirteen (ONC69, NB76, **NB78A** and **NB78B**, NSD85, **NSD86**, NSD87, NBD89) have also had mold cleaned out of the house.

Of the nineteen houses reporting condensation on the windows, sixteen report cleaning mold from the house. Four of the houses reporting condensation and mold had no evidence of water leakage (ONC71, NSD72, NSD97 and NSB98).

[6] Bold letters indicate the houses that were monitored, an underline indicates the houses that were included in the field study but not monitored.

1.5 Heating and Ventilation Characteristics

A table showing heating and ventilation characteristics is shown in the Appendices at Section 6.5.

Primary heating systems were as follows: six houses reported no heating system at all (OND74, NSD80, NSA82, NSD87, NSC91, NSB98)[7], nine houses had electric baseboard (**NS78A** & **NS78B**, ONB79, NSB83, NSA88, NBD89, NSB90, NSB94), three had oil-fired equipment (NSD72, NSD92, **NSC96**), three had propane-fired equipment (NSB93, NSA99, NSB101), six had EPA woodstoves (ONA70, NSB76, ONA84, NSD85, NSD86, NSB97) two had non-EPA units (**NSD68**, ONC69), and one house had an open fireplace as the main heating system (NSA81) and two houses listed 'other' as their main heating system (NSA73 – unknown, **NSB95** – wood furnace).

Secondary heating systems were as follows: three houses had electric baseboard (ONA84, NSD87), two houses had an EPA-approved woodstove (NSA88, NSB94), one house had a non-EPA unit (**NSC96**), two houses had open fireplaces (ONC69, ONB79,) and one had a fireplace insert (not identified as EPA or non-EPA) (NSB101). Two houses reported 'other' as a secondary heating system (ONA84, NBD89).

Of the nine houses with electric baseboard as primary heating, four had a secondary system (non-EPA woodstove, EPA woodstove, open fireplace and 'other') (ONB79, NSA88, NBD89, NSB94 respectively). One of the houses with oil-fired equipment as a primary system had a non-EPA woodstove as a secondary system (**NSC96**). Two of the houses with propane-fired equipment also had non-EPA wood-burning appliances (NSB93, NSB101). Of the eight houses that showed any type of wood-burning appliances as the primary heating system, four had secondary systems: one open fireplace, one electric baseboard, one open fireplace backing up a non-EPA woodstove, and one 'other' (**NSD68**, ONC69, ONA84, NSD85 respectively).

Eight of the houses had some type of ventilation system in them: four had bathroom and/or kitchen range hood (**NSB78A**, **NSB78B**, ONB79, NSD87), three had air exchangers (NSA73, NBD89, NSB101) and one house had an HRV installed (NSB83).

All three of the commercial rental units included in the field study group had a functioning primary heating system and a bathroom and/or kitchen range exhaust.

[7] Boldface indicates monitored house, an underline indicates the house was included in the field study.

PART TWO: FIELD STUDY

Twenty-two of the respondents own seasonal houses in Nova Scotia. Of these 22, a short list of twelve houses was created. These houses best represented a wide range of home types, foundation types, heating/ventilation systems, glass orientations and power possibilities as well as a range of 'just musty' to severe mold problems. The participation of 11 owners (and 12 houses) was confirmed, but only ten houses were included in the site visit/monitoring program, as homeowners were unable to commit to the field study.

2 Field Study Houses

There is a wide range of house types and styles in the field study choices. There is one uninsulated cottage with a pole foundation, six weatherized cottages (two with poured concrete basements, two with an insulated poured concrete closed crawlspace, one with a closed crawlspace). Three of these cottages (the ones on crawlspaces) are owned by rental companies. The sixth insulated cottage is a slab-on-grade building with an open crawlspace addition. There is one uninsulated house and two weatherized houses, one with a poured concrete basement and the other with a full-depth stone basement.

The table that begins on the next page lists the homes the general characteristics, the level of participation in the field study, the moisture problems indicated by homeowners and those observed by the study team. Column three indicates the recommendations made and the actions taken by the homeowner.

Of the ten houses followed through the study, eight carried out some or most of the recommendations made to reduce moisture problems. Five of these eight houses were monitored for temperature and relative humidity levels from November through April for two years (from Nov 2003 through the end of April 2005). All five homeowners carried out most, if not all of the project team's recommendations in the summer of 2004.

As all of the houses in the case study are in Nova Scotia, the 'NS' has been dropped from the file name. They are grouped in the four house-type categories for the remainder of the report, that is: uninsulated cottage, weatherized cottage, uninsulated house, and weatherized house.

The following legend identifies problems as indicated by homeowners on survey
A = Airout at beginning of season
M1= Mold observed when house is opened
M2= Mold observed during season that house is open
M3= Mold has been observed and cleaned at some time
W1= Standing water problems
W2= Evidence of water leakage
C = Condensation observed on windows

2.0.1: CHARACTERISTICS OF FIELD STUDY HOUSES

UNINSULATED COTTAGES

Exterior of house, facing Bay of Fundy (S-SW)

Interior: mold @ shower

Interior: abundant permeable surfaces

A81	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit airtightness test results: 12.3 AC/H	Built in 1950s Single storey w/high ceilings on pole foundation Uninsulated 'barn' construction Single pane windows all with shutters, no awnings, 40% of glazing oriented to SW Open fireplace, no ventilation 100m from ocean, surrounded by mature trees Moisture problems: A, W1, W2 Mold problems on wall surfaces of water closet and shower enclosure, which are located in the centre of the building	Roof and siding repair Re-grade around perimeter Add bathroom fan in WC and shower enclosure to reduce moisture build-up and mold growth potential No recommendations were carried out in this house

Weatherized Cottages

Interior: minimal permeable surfaces

Interior: mold growth at rail of single hung window

B78A	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit **Temp & RH monitored** airtightness test results: 3.55 AC/H	Built in 2002 Rental bungalow on closed crawlspace, poured concrete walls and slab Insulated 2x6 construction (R20 walls/R32 clg) Double-paned single hung windows no shutters or awnings, 50% of windows face SW Electric baseboard, bath/kitchen exhaust 450m from ocean, in clearing in mature spruce forest Moisture problems: A, M1, W2, C One of two identical side-by-side rental units Condensation problems/mold growth at the rail of the single-hung windows Musty smell upon opening after winter	Close crawlspace vents Improve attic hatch seal Keep bath fans on as much as possible (these are toggled for guests to turn off) Install 'shrink wrap' on windows to reduce/eliminate condensation problems Changes were made at the beginning of the summer 2004, improvements were noted by the fall There was not much mold to begin with, but there was an improvement, particularly near the windows

Exterior: B78A and B78B are identical rental units

Interior: dry crawlspace

Exterior: crawlspace vent at grade

B78B	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit Temp & RH monitored airtightness test results: 3.86 AC/H	Built in 2002 Rental bungalow on closed crawlspace, poured concrete Insulated 2x6 construction (R20 walls/R32 clg) Double-paned single hung windows no shutters or awnings, 50% of windows face SW Electric baseboard, bath/kitchen exhaust 450m from ocean, in clearing in mature spruce forest Moisture problems: A, M1, W2, C One of two identical side-by-side rental units Condensation problems/mold growth at the rail of the single-hung windows Musty smell upon opening after winter	Close crawlspace vents Improve attic hatch seal Keep bath fans on as much as possible (these are toggled for guests to turn off) Install ‘shrink wrap’ on windows to reduce/eliminate condensation problems Changes were made at the beginning of the summer 2004, improvements were noted by the fall There was not much mold to begin with, but there was an improvement, particularly near the windows

Exterior: front elevation

Ext: poor drainage @ flat roof, damage @ foundation Ext: poor detail @ grade Interior: condensation on all windows

B90	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team meeting airtightness test results: 15.39 AC/H	Built in 1970s with addition in 2002 Single storey, original flat –roofed house on lab-on –grade with gable-roofed addition (insulated 2x6 walls) w/open crawlspace (wood subfloor and posts) Variety of window types, no awnings or shutters, 65% of glazing oriented E In well-forested area about 10m away from lake Electric baseboard, no ventilation Moisture problems: A, W2 Water damage apparent on side of house due to poor drainage of flat roof Poor grading around new and old foundations	Repair/refit downspout off flat roof Regrade to reduce water penetration at foundation perimeter (for both slab and crawlspace) Homeowner repaired/refitted the downspout off flat roof to eliminate the possibility of water penetration down the side of the house to foundation No other recommendations were carried out on this house

Exterior: much of house in constant shade

Interior: heavy mold growth in bathroom, on railing @ loft

B90	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit **Temp & RH monitored** airtightness test results: 8.93 AC/H	Built in 1980s 1-1/2 storey 2x6 construction (R20walls and clg) 'dug out' basement w/open vents Mainly double-pane vinyl windows, no shutters or awnings, 40% of glazing oriented SE In a well-forested area, about 5m away from river Wood furnace, no ventilation Moisture problems: A, M1, W2 C	Extensive recommendations were made for this house, most were carried out: A complete clean up Basement vents closed off Isolation of basement/crawl-space area from house Thinning of trees around the homesite to allow for more air movement There was no evidence that mold was returning after these recommendations were carried out

Exterior: wheelchair accessible rental unit

Crawlspace: moisture due to drainage problem

Interior: mold @ tiled shower, condensation @ rail of window

B95	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit airtightness test results: 1.63 AC/H	Built in 2000 Rental bungalow on closed crawlspace, poured concrete 2x6 construction (R20 walls, R30 clg) Double pane windows , no shutters, awnings to SW, 50% of glazing oriented SW Gas space heater (disconnected), no ventilation 200m from river, cleared site (and in proximity to ocean) Moisture problems: M3, C	Remove propane wall furnaces (water leakage @ exhaust pipes led to mold growth on wall behind units where vapour barrier was broken) Replace showers with all-tiled units ('walk-in' units) Seal penetrations from crawlspace, fix water penetration areas Every recommendation was implemented in winter/spring 2004 There was no evidence that mold was returning after these recommendations were carried out


Exterior: right rean, shows walkout with poordrainage, left front shows rainwater leader in wrong position (should be at 90° from present position to drain away from house)



Basement: linoleum hides mold growth, gas and paint supplies stored in basement permeate house.

B101	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit airtightness test results: 13.5 AC/H	Built in 1950s Bungalow-style cottage built on full basement, concrete block walkout (was originally fully raised basement, landscaped in late 1960s) 2x4 construction with some insulation Double pane wood casements throughout, no awnings or shutters, 50% of glazing oriented NW Oil forced-air system with fireplace insert, kitchen exhaust. About 400m from ocean on treed lot Moisture problems: A, W1, W2, C	Lift linoleum in kitchen and basement to allow floors to dry out Inspect roof drainage/wall cavity on kitchen side for water penetration Install a bathroom fan w/humidistat Regrade exterior for positive slope and extend rainwater leaders Remove paint and gas containers from basement Homeowner lifted linoleum, removed gas and paint containers from basement, no other recommendations were carried out

Uninsulated House

Exterior: West Elevation

Interior: water damage @ window sill *Exterior: vents too close to grade* *Exterior: standing water on flat roof*

C96	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit **Temp & RH monitored** airtightness test results: 16.93 AC/H	Built 1940, three additions (1960/80, 2003/4) Original one-storey cottage on open crawlspace (conc. block), slab-on-grade addition (poured conc.), newest addition on open crawlspace (conc. block) Latest addition insulated but not finished at site visit. Various window types throughout, no awnings or shutters, about 65% of glazing oriented N Oil forced-air with non-EPA woodstove, no ventilation 20m from ocean (to N) Moisture problems: M1, M2, W1, W2, C	Put continuous vapour barrier down over dirt floor Install two small inline fans to exhaust crawlspaces Homeowner covered dirt floors in crawlspaces with polyethylene sheets, installed two small inline fans to exhaust stale/moist air from crawlspaces The fans will be used when the cottage is opened, not run through the winter

Weatherized Houses

Exterior: SW elevation

Foundation: moisture damage

Interior: kerosene lamps damage ceilings

D68	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team site visit Temp & RH monitored airtightness test results: 19.82 AC/H	Built in 1860s Two storey farmhouse on full basement, stone foundation w/dirt floor, partially insulated walls and ceiling Single-pane double-hung windows with storms, no awnings or shutters, windows evenly distributed Non-EPA woodstove and cookstove, no ventilation In a field, inland location more than 400m from water body Moisture problems: A, M1, M3, W2, C	Clean out basement Put continuous vapour barrier down over dirt floor Cleaning out basement and putting down vapour barrier over the summer dramatically improved the smell and reduced the humidity Homeowner to install gutters before winter and grade exterior slope

Photo unavailable		
B78B	Brief Description of House	Recommendations/Results
EGH and IAQ audit project team meeting airtightness test results: 4.62 AC/H	Built in 1980s Single storey house on full basement, poured concrete (slab was poured in 2000) 2x6 construction (R20 walls/?clg) Mainly double pane single hung windows, no shutters or awnings, windows are evenly distributed EPA woodstove, no ventilation 35m from lake in a well-forested area Moisture problems: A, M1, M3, W1, W2, C	Close basement vents Clean up basement contents Cover sump Install bathroom fan Cover windows with 'shrink wrap' to eliminate first condensing surface Homeowner closed off vents in basement as recommended, installed cover on sump, removed gas containers from basement Homeowner to install exhaust fan and finish drywall on the ceiling

3 Monitored Field Study Houses

Five of the houses were outfitted with Oakton Temperature and Relative Humidity sensors. Data, in the form of monthly tables, for each of the houses for the two year monitoring period can be found in the Appendices, Section 5. The houses monitored were as follows: B78A and B78B, B95, C96 and D68.

There are two houses with complete data sets for the winter of 2003 (NSB78A and NSB95). There are four houses with complete data sets for winter 2004 (NSB78A, NSB78B, NSB95 and NSD68). There are two houses with complete data sets for both years (NSB78A and NSB95).

Field Study Data, First Year (2003-2004)

Each house shows a high spike of temperature around the following dates: November 22-24, November 30-December 1, December 14, 20-21, 26-27, January 19-25, Feb 18-19, Mar 19-20 and 25, and April 19-23. These spikes equate to weather events, and there was a corresponding spike with RH values when these weather events included periods of rain, drizzle or heavy fog, where the exterior RH was above 90%.

Field Study Data, Second Year (2004-2005)

Each house shows a high spike of temperature around the following dates: November 27/28, December 12 and 23/24, January 15 through 17, Feb 9 through 11, March 9, and April 17/18. These spikes equate to weather events, and there was a corresponding spike with RH values when these weather events included periods of rain, drizzle or heavy fog, where the exterior RH was above 90%, or quick thaw periods in early spring.

Weather Note

There is a consistently higher RH level in all of the monitored houses in the 2003/2004 monitoring period than in 2004/2005. This could be attributed to Hurricane Juan, which hit Nova Scotia September 29th, 2003, and dropped 25 to 40mm of rain in about 12 hours. Overall, there was almost 60% higher precipitation than normal in Sept 2003, as measured at Halifax International Airport. Figures from Environment Canada[8] indicate that December 2003 was also a very wet month, with the same weather station reporting 30% higher precipitation than normal. For the period between December 2003 and February 2004, Environment Canada shows that precipitation was 20% less than the 30-Year Normal. At the time of writing, there are no figures available for the same dates in 2004, the second year of monitoring. A random sampling of RH levels recorded at Halifax International Airport throughout November and December of both years shows that

[8] http://atlantic-web1.ns.ec.gc.ca/climatecentre/default.asp?lang=En&n=BDF9851E-1. 'Normal' refers to the 30 year normal, as measured between 1971 and 2000.

exterior RH values were generally higher in 2003[9]. The following table shows the overall average RH values by month for year one and two of the monitoring period. On average, the houses saw RH values about 14% higher in 2003 than in 2004. With temperatures in November 2003 averaging 5°C higher than in 2004, it is certain that the houses hit the dewpoint more often throughout the fall and early winter of 2003.

3.0.1 OVERALL AVERAGE RH VALUES/MONTHLY

	Nov	Dec	Jan	Feb	Mar	Apr
2003/2004	79.2	78.8	75.2	70.4	70.7	74.7
2004/2005	59.7	68.2	66.9	65.5	64.1	61.4
Difference between year 1 and 2 in %RH	19.4	10.7	8.3	4.9	6.6	13.3
% diff. in ave. RH between year 1 and 2	25%	13%	11%	7%	10%	18%

[9] http://climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

3.1 Weatherized Cottages B78A and B78B





These identical bungalows, built in 2002, are rental units within 20m of each other on a property located on Nova Scotia's South Shore. They are well-constructed on dry crawlspaces with 2x6 walls and truss roofs. The owners had noted that B78A showed more mold growth and/or the results of condensation (discolouration, staining etc. on woodwork) than B78B. B78A is in a more shaded location than 'B'. However, it is unclear whether the more shaded location is the cause of the higher RH levels. One datalogger was hung in each of the units, in the middle of the building.

These rental units were built to a higher standard than the other monitored houses, with air leakage rates of 3.55 and 3.86 air changes per hour (AC/H) respectively, the level of current residential construction. As well, as rental units, the level of expected cleanliness was much higher than in the other houses in the survey and in the field study sample. The owners were much more aware of the presence of mold and condensation stains than other owners, and the cottages were cleaned more thoroughly and more often than the other field study houses. Even so, there was evidence of mold growth in the bathrooms of both units, and mold on the

vinyl window frames from condensation both during the season of use and when the buildings were shut down for the winter.

The recommendations for these two cottages included closing crawlspace vents seasonally, tightening attic hatches and sealing the single-hung windows with plastic wrap over the winter season, when the business is closed down. This last recommendation was made because the owners complained of cleaning the window sashes and sills in the fall and in the spring. A blower door test confirmed that there was some air leakage at the sash, typical for this type of window. The plastic wrap reduces or eliminates the air leakage at the sash and also moves the first condensing surface to the warmer side of the plastic, away from the window (both these cottages have double glazed units).

Data was not recorded for B78B for the period of November – December 2003, so no comparison can be made from the early part of the year. However, from January on, the two cottages have significantly varying RH levels, yet nearly identical temperature regimes. There is a consistent difference in RH range that leaves an overall average RH for 'A' about 15 points higher than 'B'. Also, graphically, the RH has slightly higher peaks in A' when the RH goes up (typically associated with temperature drop) and slightly deeper valleys in 'B' when the RH goes down. However, there were no periods of extreme RH spikes (greater than 5 percent difference) in either year that could not be attributed to a weather event.

For the second year of monitoring, the RH levels were more in line with each other. Temperature regimes are again almost identical, except for a few days in late April, when B78A may have been rented, as the temperature ranges from 17 to 19°C overnight on the 16th, the 23rd and from the 28th onwards.

The table below shows the change in the averaged monthly RH levels between the two cottages.

3.1.1.1 AVERAGE RH BY MONTH, B78A AND B78B

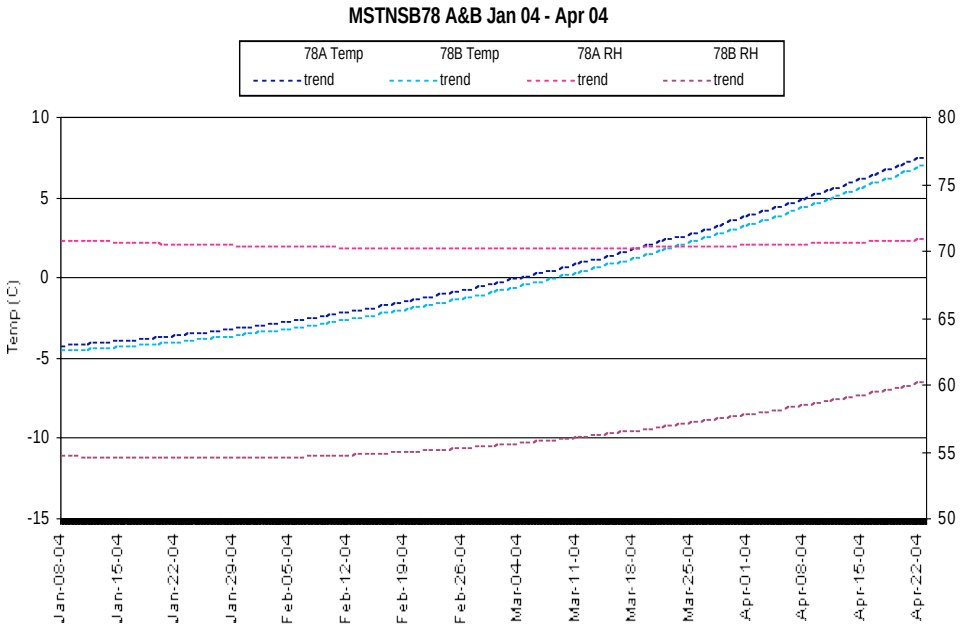
	Nov	Dec	Jan	Feb	Mar	Apr	Ave
2003/2004							
B78A	75.2	75.3	72.8	69.5	70.6	71.6	71.1
B78B	--	--	54.9	54.2	56.8	59.3	56.3
Difference, RH%	--	--	17.9	15.3	13.8	11.7	15.3
% Difference	--	--	25%	22%	19%	16%	21%
2004/2005							
B78A	53.8	66.2	68	65	64.5	61.8	63.2
B78B	59.9	64.2	64.8	64.6	63.2	61.2	63
Difference, RH%	6	2	3.1	0.4	1.3	0.6	2.2
% Difference	10%	3%	5%	1%	2%	1%	4%

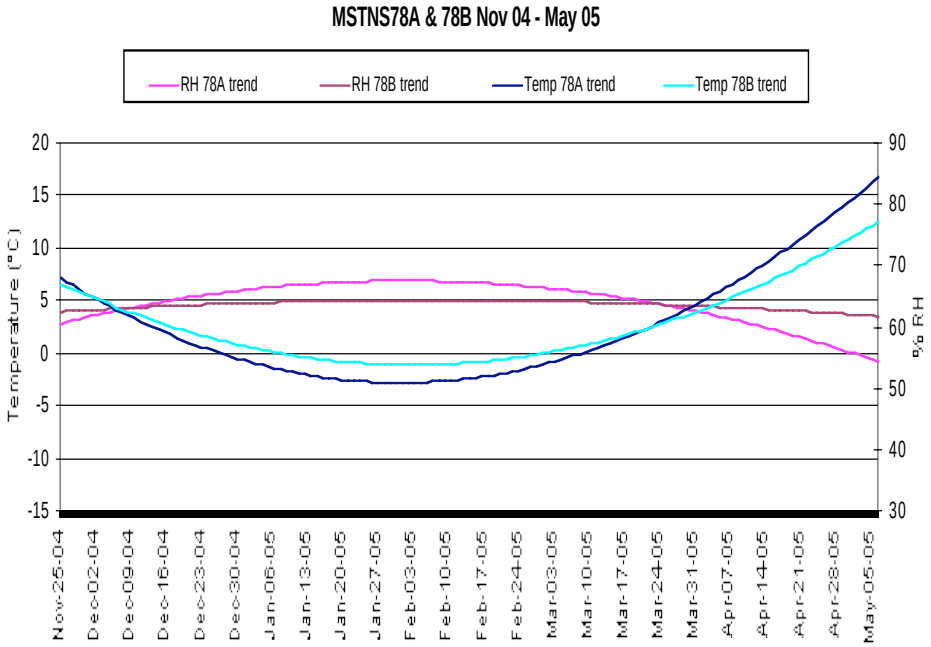
Of interest, too, will be the changes noted in the range of RH levels in these two side-by-side cottages. With the recommendations carried out by the owners, the cottage that was showing the most evidence of mold and condensation problems, B78A, had a remarkable drop in the average RH level and the range of RH readings by month as well, as noted in the chart below. The range of B78A was still reaching higher RH levels than 'B'. This could be a result of the slightly different siting.

3.1.1.2 RH RANGE, B78A & B78B FOR 2003/2004 AND 2004/2005

2003/2004	Nov	Dec	Jan	Feb	Mar	Apr
B78A	74 - 77.5	72 - 79	62 - 79.5	64.5 - 82.5	67 - 82.5	22 - 82.5
B78B			49.5 - 60.5	49.5V56.5	53- - 60	15.5 - 75.5
2004/2005						
B78A	28.5 - 64.5	50 - 78.5	58 - 83.5	48.5 - 75.5	52.5 - 75.5	40.5 - 75.5
B78B	18 - 64.5	61 - 68	60.5 - 68.5	60.5 - 68.5	60 - 82.5	31 - 67

Temperature and RH trends were noted in these two cottages for both years, as shown in the following charts. 'A' shows a consistently higher temperature in 2003/2004. The same trends plotted for the second year show a different story, where 'A' has a slightly lower temperature curve than 'B' over the colder months of the year, but 'B' shows a higher temperature trend in the spring.The first year shows a concave trend for RH in both cottages, with a higher, slightly less concave line for the RH in B78A. The RH curve in B78A is fairly flat in the first year of the study, but much higher in general than that of 'B'. In the second year of the study, the RH curve in 'A' is much stronger than in 'B', and both are convex as opposed to concave. However, both are well under the 70% RH line of the graph, showing a significant reduction in overall RH levels in 'A'.


MSTNSB78 A&B Jan 04 - Apr 04
78A Temp
78B Temp
78A RH
78B RH
trend
trend
trend
trend
Temp (C)
10
5
0
-5
-10
-15
80
75
70
65
60
55
50
Jan-08-04
Jan-15-04
Jan-22-04
Jan-29-04
Feb-05-04
Feb-12-04
Feb-19-04
Feb-26-04
Mar-04-04
Mar-11-04
Mar-18-04
Mar-25-04
Apr-01-04
Apr-08-04
Apr-15-04
Apr-22-04


MSTNS78A & 78B Nov 04 - May 05
RH 78A trend
RH 78B trend
Temp 78A trend
Temp 78B trend
Temperature (°C)
20
15
10
5
0
-5
-10
-15
90
80
70
60
50
40
30
% RH
Nov-25-04
Dec-02-04
Dec-09-04
Dec-16-04
Dec-23-04
Dec-30-04
Jan-06-05
Jan-13-05
Jan-20-05
Jan-27-05
Feb-03-05
Feb-10-05
Feb-17-05
Feb-24-05
Mar-03-05
Mar-10-05
Mar-17-05
Mar-24-05
Mar-31-05
Apr-07-05
Apr-14-05
Apr-21-05
Apr-28-05
May-05-05

3.2 Weatherized Cottage B95





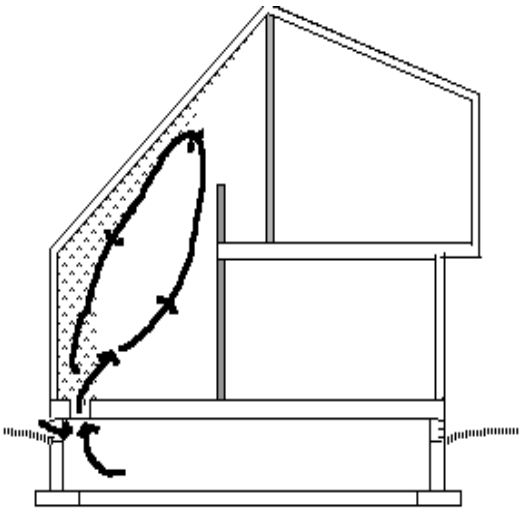

This weatherized cottage was built in the 1980s, with typical 2x6 stick frame details. A one-and-a-half storey building, it sits on a crawlspace that has a 'dugout' area that houses a wood furnace. This foundation has poured concrete walls and slabs throughout, with four vents – left open continuously – directly at grade level. The wood furnace was connected to the main floor via unsealed ductwork. The air tightness test result, 8.93 AC/H, indicates that this house has a high level of air leakage.

The house had been uninhabitable for two years prior to the study because of high levels of mold. The pattern of mold growth was difficult to discern, initially, it seemed that there was no pattern at all. Closer inspection showed a definite 'tide line' on the sloped ceiling, almost directly in line with the railing of the loft.

FIGURE 1: X-SECTION OF HOUSE B95

The cold exterior surfaces cool the interior air quickly, causing condensation on the interior sloped ceiling and wall surfaces

Cold air enters at the crawlspace vents.



The convection loop is strong, driven by the cold air from the crawlspace but is confined mainly to the 2 storey space that runs the length of the building

There was some evidence of mold in the loft area, but not the overwhelming presence found on the main floor. The crawlspace also showed less evidence of mold growth, at least on exposed surfaces. The house is tucked deep into a well-forested site, but sits on a point made by a bend in the nearby river.

Due to the extensive mold growth and the odd pattern of mold growth in the house, two dataloggers were hung in this house, one on the main floor under the loft but in the main living area, and one on the upper floor, centre of the loft.

Recommendations started with scrubbing all surfaces down and letting the building air dry over the early part of the summer, with severely damaged surfaces to be removed and the whole interior being repainted with an oil-based paint. The original paint was also oil-based, which may have helped reduce the damage to the drywall from the mold growth). The crawlspace was then sealed off from the main floor. This included sealing off the supply and return ducts for the forced air system, which was not a problem, as the homeowners wanted to install an EPA woodstove on the main floor to use as their primary heating source. The foundation vents were blocked off and the cleanout to the wood furnace chimney was left open. It was recommended that the trees around the house be limbed to allow more air movement in and around the house. There was significant mold and moss growth on all exterior surfaces of the house and surrounding structures as well, which stopped at the edge of a deck and stairway to a landing on the river. Both the deck and stairway were well out of the protected forest area, receiving sunlight and unobstructed breezes.

Once the recommendations were carried out, the mold growth was checked significantly. Two years later, the homeowners are extremely pleased with the results and have been able to use their cottage on a regular basis.

Over the first year of monitoring, the house showed a slightly higher temperature regime in the upper floor than in the main floor. The upper floor also had temperature spikes that were higher than those of the main floor. The RH spikes throughout the first year were very different between the main and upper floors. The main floor saw RH spikes of about 5 to 10 percent during weather events, while the upper floor saw spikes of upwards of 25 percent RH. After recommendations were carried out, the second year of monitoring shows the same RH spiking, the upper floor is not spiking quite so high, with only 15 to 20 percent increases. However, the RH values at the upper floor remained, on average, higher than the lower floor. Spikes that raised the RH to above 90 percent on the upper floor happened 24 times in the first year versus 17 times in the second year.

The table below shows the change in the averaged monthly RH levels on the main and upper floors. The first year shows the main floor average dropping below seventy percent during February and March, while 2004/05 shows the main floor average is consistently under seventy percent, and an overall drop of 8.6 in average RH level on the main floor. The upper floor, too, saw an overall average drop of 8.3 in RH level, however, the average is still over 70 percent for most of the second year of monitoring. Table 3.1.5.2 shows

the range of the RH levels on the main and upper floors over the two years. Where the main floor maximum RH has dropped, the upper floor still sees periods of near saturation levels.

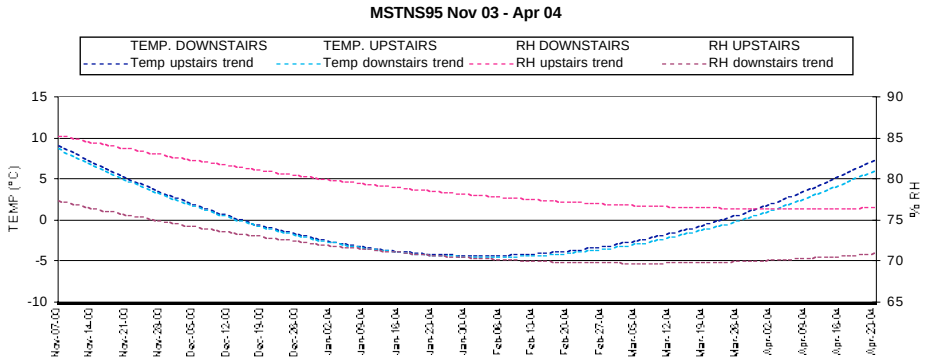
3.2.1.1 AVERAGE RH BY MONTH, B95, UP AND DOWN

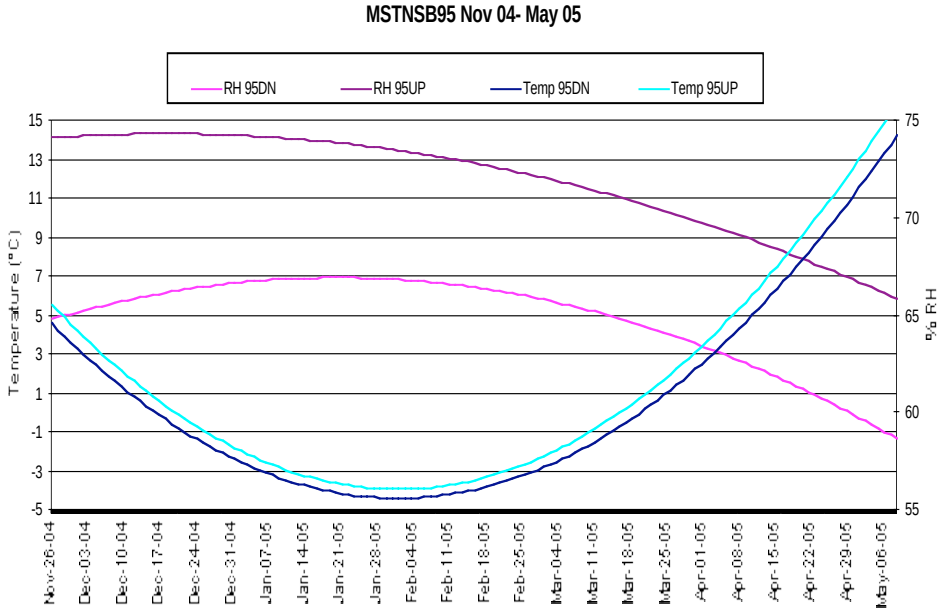
	Nov	Dec	Jan	Feb	Mar	Apr	Ave
2003/2004							
MAIN FLOOR	77.2	76.9	73.1	67	66.5	74.3	72.5
UPPER FLOOR	85.1	84.4	79.6	74.7	75.2	78.9	79.6
Difference, RH%	7.9	7.5	6.5	7.7	8.7	4.6	7.1
% Difference	9%	8%	8%	10%	11%	6%	9%
2004/2005							
MAIN FLOOR	56.6	68.6	65.9	64.7	65.6	62.3	63.9
UPPER FLOOR	67.2	76.2	73.3	71	72.1	68.3	71.3
Difference, RH%	10.6	7.6	7.4	6.3	6.5	6	7.4
% Difference	16%	10%	10%	9%	9%	9%	10.5%

3.2.1.2 RANGE RH BY MONTH, B95, UP AND DOWN

2003/2004	Nov	Dec	Jan	Feb	Mar	Apr
MAIN FLOOR	75 - 81	72 - 83.5	66 - 80	54.5 - 99	49.5 - 99	41.5 - 99
UPPER FLOOR	87.5 - 99	77.5 – 99	71.5- 90.5	61.5 – 99	51.5 - 75.5	28- -99
2004/2005						
MAIN FLOOR	32.5 – 70.5	61.5 - 80	58.5 – 75.5	57.5 – 78	58 – 78	30.5 - 77
UPPER FLOOR	38.5 – 97.5	65.5 – 99	62.5 – 99	60.5 – 97	60.5 – 97	26.5 - 95

RH trends for this house are shown in the following two charts. The temperature curves over the two years follow similar concave patterns, as seen in all of the houses. The RH patterns, however, are opposite to each other over the two years of monitoring. A wider gap is seen between the main and upper floors in general after recommendations were carried out, however, the trendlines for both floors are below 75%RH in the second year, while they are above 70%RH in the first year.




MSTNSB95 Nov 04- May 05
RH 95DN
RH 95UP
Temp 95DN
Temp 95UP
Temperature (°C)
% RH
15
13
11
9
7
5
3
1
-1
-3
-5
75
70
65
60
55
Nov-26-04
Dec-03-04
Dec-10-04
Dec-17-04
Dec-24-04
Dec-31-04
Jan-07-05
Jan-14-05
Jan-21-05
Jan-28-05
Feb-04-05
Feb-11-05
Feb-18-05
Feb-25-05
Mar-04-05
Mar-11-05
Mar-18-05
Mar-25-05
Apr-01-05
Apr-08-05
Apr-15-05
Apr-22-05
Apr-29-05
May-06-05

3.3 Uninsulated House C96

This house was originally built in the 1940s, with two early additions and a current upper floor addition. There are two distinct crawlspace areas and a slab-on-grade portion to the foundation. The crawlspaces, the areas of attachment/opening between the original house and the additions as well as the connection between the new upper floor and the existing main floor all showed large air leakage problems (the airtightness test showed an leakage rate of almost 17 AC/H). Addressing the issue of air leakage transference was nearly impossible, however, the owners complained of a consistent musty smell in the sitting room over the original crawlspace foundation. The main recommendation for this house was to install a vapour barrier on the dirt floors of the crawlspaces and also to install a small fan and duct system that could be used to depressurize the crawlspaces to reduce the amount of musty, damp air in the house when occupied. See following sketch for details of proposed crawlspace ventilation system.

Unfortunately, the datalogger malfunctioned during the first collection period (November and December 2003). What was thought to be a faulty battery was replaced for the second year of monitoring, but the sensor malfunctioned again, recording only the temperature levels in the house except for a few spotty RH values towards the very end of the data acquisition period.

The first year data is interesting, however. January 2004 shows a fairly consistent temperature range (between 0 and 4°C, with an average temperature closer to 2°C), and wild fluctuations in RH, from 70 to 28%. The end of January shows more temperature fluctuation, which continues through the spring. This house shows the type of relationship between temperature fluctuation and RH levels that was expected from the field study, where sharp drops in temperature show corresponding spikes in RH levels, and temperature rises show corresponding drops in RH levels. Throughout February, the temperature ranges from 2 to –9°C, with a typical 24 hour period showing a difference in temperature of between 6 and 9°C. This diurnal pattern shows up strongly in March 2004,where a pattern of opposing peaks and valleys can readily be seen. Temperatures range from –2 to 7°C at this point, with roughly 14% RH change on any given day. April shows a continuation of this trend, with temperatures fluctuating between 3 and 12°C daily, and RH changes limited to a range of 55 to 75 until April 21st, when a dramatic temperature spike (over 25°C) drops the RH down to 34%. After this, the temperature is consistently above 15°C, and the RH ranges between 40 and 55%. The pattern of temperature drop/RH rise, temperature rise/RH drop is still apparent.

3.3.1.1 AVERAGE RH BY MONTH, C96

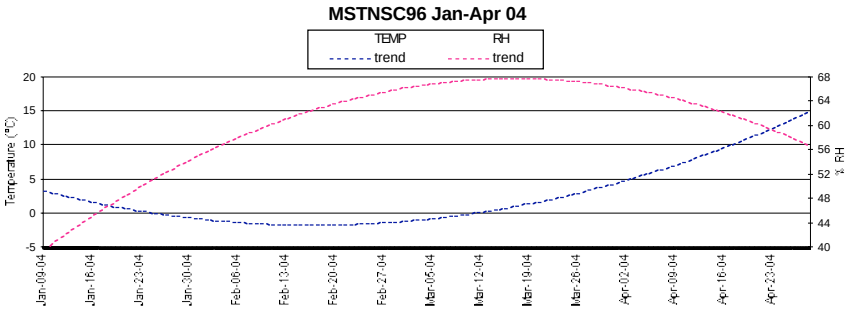
	Nov	Dec	Jan	Feb	Mar	Apr	Ave
2003/2004							
MAIN FLOOR	--	--	49.3	61.8	66.7	63.7	60.4

3.3.1.2 RANGE RH BY MONTH, C96

2003/2004	Nov	Dec	Jan	Feb	Mar	Apr
MAIN FLOOR	--	--	37 – 73	49 – 71	55 – 77	34 - 77

With averages well under 70% RH throughout the monitored time, and reasonably low RH ranges in each of the four months, this house has favourable drying conditions. The musty smell was most likely emanating from the crawlspace. There were vents on three sides of the foundation, and these were closed off so that the

fan system could effectively remove moist air from the crawlspace. The parameters for the design of the system came from the Minnesota building code, crawlspace ventilation requirements.



3.4 Weatherized House D68





This house was built in the 1860s, on a stone foundation with a dirt floor. The main issue with moisture and mold were based in the foundation area, and the recommendations reflect this, starting with clearing out the foundation and laying down a continuous sheet of polyethylene. The homeowner also resurrected a drainage pipe that the original builders had incorporated into the foundation floor to help keep it from flooding. Further recommendations included regrading the exterior to drop the grade line below the top course of stone and maintain a slope away from the exterior walls and installing eavestroughs with rainwater leaders and/or waterbarrels to eliminate as much surface water from reaching the foundation as possible.

The homeowner carried out the interior recommendations and was extremely pleased with the resulting decrease in musty odours in the living space, and the observably drier basement throughout the fall of 2004. She planned to carry out the exterior recommendations (regrading and eavestroughing) in the spring of 2005, however, a late spring rainstorm caused serious flooding before she could have this work done (but after the datalogger had been removed). Her observation was that the original drain worked extremely well to clear the standing water once the storm was over, but the basement was once again very wet this year.

In terms of air leakage, this old farmhouse had some unfinished areas and had an air change rate of nearly 20 AC/H. Addressing air leakage areas in this house was out of the realm of this study.

The datalogger in this house also malfunctioned in the first year, giving data only for November and December of 2003, and January 2004. A new battery was installed in early January, and malfunctioned. The second year data is complete. In November and December of both years, there is little evidence of RH increase through dropping temperatures. There are spikes in both temperature and RH, most of which can be attributed to weather events or occasional occupation of the house. In January of both years, the house was occupied occasionally, and it is during these times, when the temperature drops significantly, from 13°C to –2°C (Jan 17/18, 2005), that there is a corresponding rise in the RH level (40 to 65%). Air at 13°C and 40% RH has a dewpoint temperature of 1.6°C, so this could be one example of a wetting event. Typically, this magnitude of temperature drop happens only when the house cools down after being occupied. On the other hand, a more typical January day sees a temperature swing from –2 to –7°C, with an RH range of 57 to 60%.

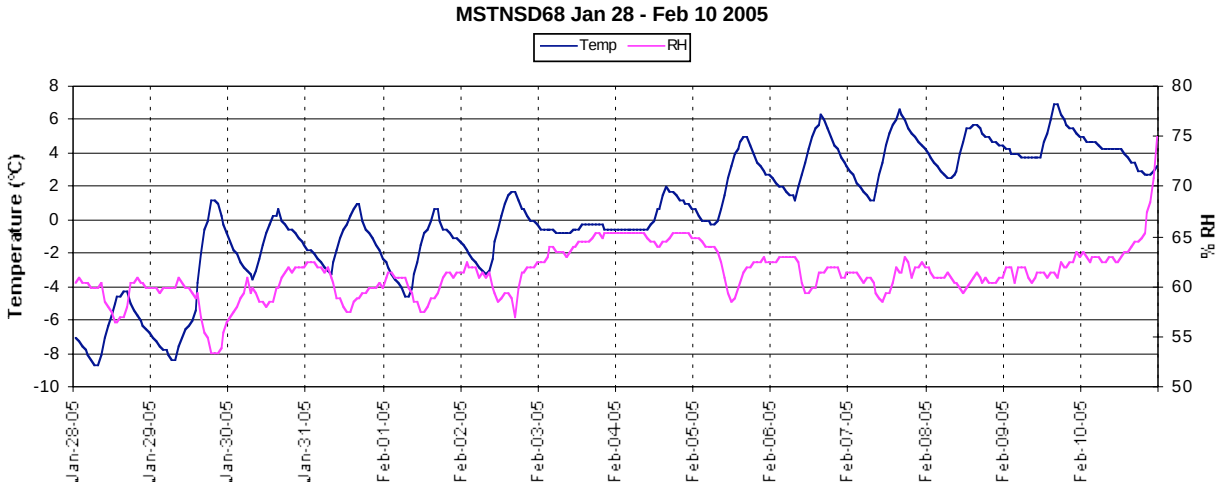
3.4.1.1 AVERAGE RH BY MONTH, D68

	Nov	Dec	Jan	Feb	Mar	Apr	Ave
2003/2004							
MAIN FLOOR	74.3	72.1	44.6	--	--	--	63.7
2004/2005							
MAIN FLOOR	61.6	65.8	62.4	62.2	55.3	53.4	60.1

3.4.1.2 RANGE RH BY MONTH, D68

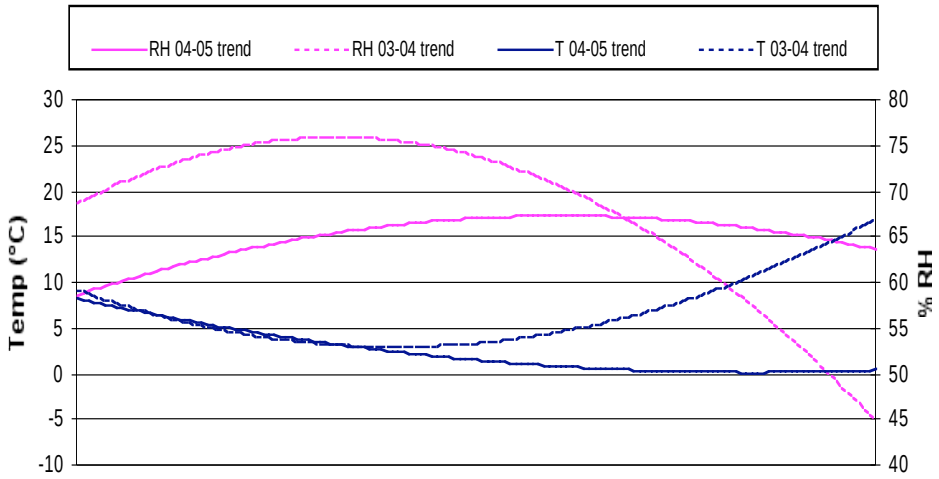
2003/2004	Nov	Dec	Jan	Feb	Mar	Apr
MAIN FLOOR	57.5 – 87.5	39 – 97.5	25.5 – 74.5	--	--	--
2004/2005						
MAIN FLOOR	43.5 – 76.5	56 – 76	47 – 81.5	54 – 79.5	25 – 79.5	31 – 76

It is in this house that the anticipated pattern of temperature drop and RH rise on a daily basis is best represented graphically for most of the monitored period. In the following sample (January 28th through February 10th 2005), the dotted vertical lines indicate midnight for each date. The temperature peak is typically between 1pm and 5pm, while the temperature low is typically between 7am and 9am.

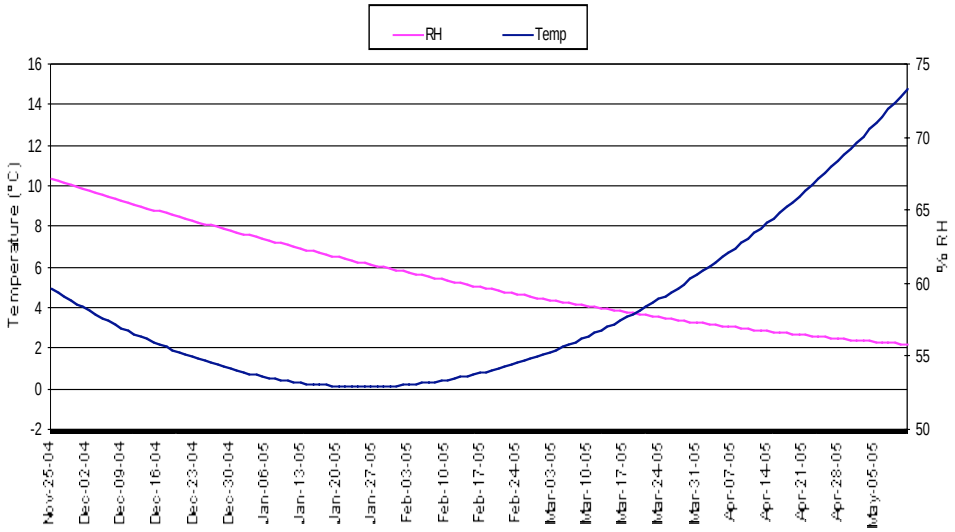


The trendlines for D68 show similar forms to those of the preceding houses. The first chart below shows the comparison between the period November through January for both years of the field study. The RH trend for 2003/2004 is higher than that of 2004/2005 until January 2003, when the house was occupied for a period of time. The overall curve of the 2004/2005 trend is very similar in shape to the trendlines of the other houses in the study.

MSTNSD86 -- Comparison of Nov-Jan data, both years



MSTNSD68 Nov 04 - May 05



3.5 Overall Trends

It was anticipated that the graphical analysis of the data would show a distinct pattern of RH rise associated with temperature drop over the 6 months of monitoring. In fact, this was only distinctly seen in two of the houses (C96 and D68), and was not seen throughout the year. More often than not, the graphs of the monthly temperature and RH regimes showed the RH levels actually following the temperature levels. While this might be considered usual in times of precipitation, it did not seem that it would be the norm.

3.5.1 Dewpoint Temperatures

When temperatures range from 10°C to 0°C on a daily basis, such as they can in November, December and March, April in Nova Scotia, dewpoint temperatures can be reached at the RH levels seen in the study houses. Monthly average RH levels in the study houses range between 60 and 77 percent. If the temperature drops from 10°C at 60% RH, the dewpoint temperature[10] is approximately 3°C, but at 80% RH, the dewpoint temperature is closer to 7°C, requiring only a 3°C drop in temperature for condensation to occur. This range of temperature swings and RH levels are prevalent during the shoulder seasons.

The following table shows examples of temperature drops and the dewpoint temperature based on the RH recorded prior to the temperature drop. The temperature drops were all within a 6 to 12 hour period on the dates indicated, for houses B78A and B, and B95, the three buildings with the most complete data sets. These three houses offer a good sample, as they are quite different from each other in temperature and RH regimes throughout the monitoring periods. Boldface numbers indicate events where dewpoint temperature was reached or exceeded in the recorded temperature drop.

Although this is a random sample of temperature drops that meet the parameters outlined above, it can be seen that the houses do experience possible ‘saturation events’ on a seasonal basis. In the table below, there are twelve examples from November/December and eleven examples from March/April, and of these twenty-three temperature drops, ten meet or exceed the dewpoint temperature over the course of the two-year study period. Seven of eight entries for house B95 (the worst-case scenario of the field study) are possible ‘saturation’ events, while three of nine entries for house B78A meet or exceed dewpoint temperatures. None of the five entries for B78B (the best-case scenario for the field study) indicate possible saturation events. Overall, these possible saturation events are split evenly between late fall/early winter and spring. Temperatures in January and February averaged below zero, reducing the possibility of reaching dewpoint temperatures, even at high RH levels because the curve of the psychrometric chart flattens out after 0°C.

[10] from psychrometric chart (°C) for air at 101.325 kPa, source: ASHRAE publications

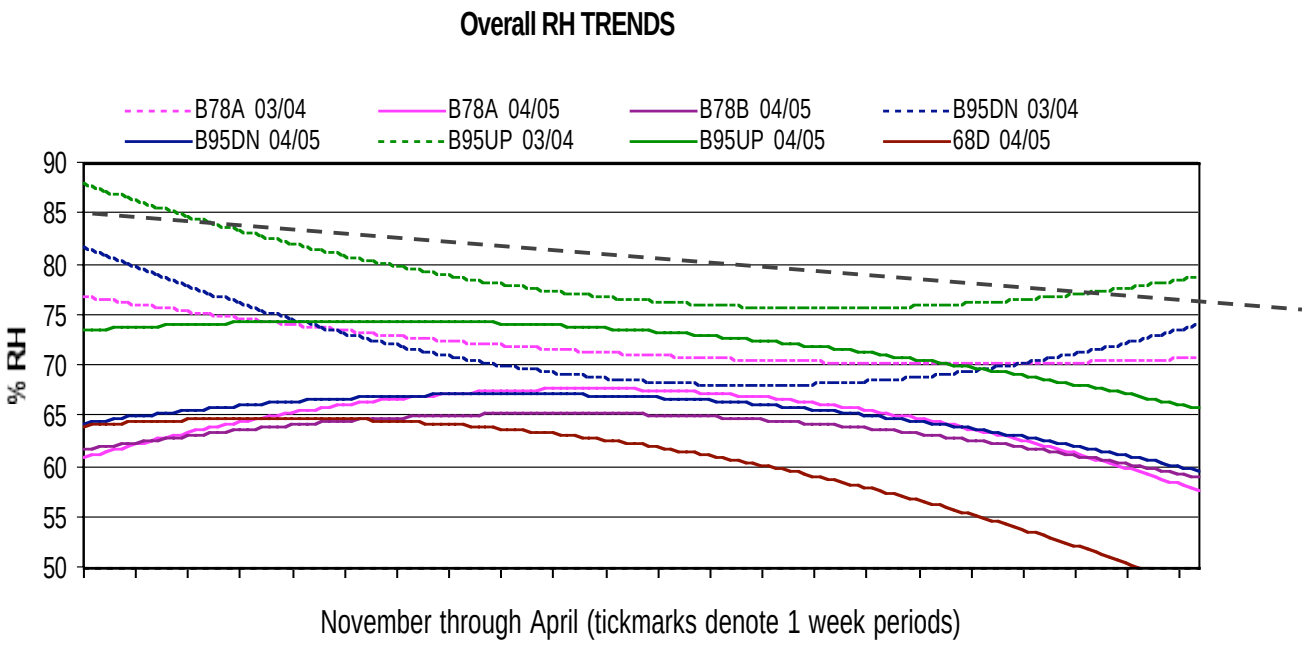
3.5.1.1 DEWPOINT TEMPERATURE AT VARIOUS READINGS

Date	House #	Temperature Drop(°C)	RH @ T peak	Dewpoint Temp. (°C)
Fall/Winter				
13 Nov 03	B95	6 to 3	74 UP 70 DN	1.5 1
18 Nov 03	B78A	6 to 3	72	1
25 Nov 03	**B78A**	**10 to 7**	**75**	**6**
27 Nov 03	**B95**	**7 to 3**	**86 UP** **78 DN**	**4.5** **3.5**
27 Nov 04	**B95**	**13 to 2**	**60 UP** **50 DN**	**5** **3**
28 Nov 03	B78A	8 to 5	76	4
29 Nov 04	B78A	10 to 4	62	3
	B78B	8 to 5	65	2
14 Dec 03	78A	5 to 2	77	1.5
24 Dec 04	**78A**	**8 to 2**	**78**	**4.5**
	78B	7 to 4	65	1
28 Dec 03	**95**	**9 to 0**	**95 UP** **83 DN**	**8.5** **7**
Spring				
5 Mar 04	**B95**	**4 to 0**	**95 UP**	**3**

			75 DN	**0**
18 Mar 04	B78A	4 to 1	70	-3
	B78B	4 to 1	55	>-5
21 Mar 05	**B95**	**5 to 0**	**70 UP**	**1**
			65 DN	-2
23 Mar 05	B78A	8 to 2	60	1
	B78B	6 to 2	63	0
28 Mar 05	B95	7 to 0	71 UP 60 DN	2 0
30 Mar 04	**B95**	**4 to –3**	**70UP**	**-3**
			62 DN	>-5
11 April 05	**78A**	**12 to 4**	**60**	**5**
	78B	9 to 5	60	2
	B95	**12 to 4**	**80 UP** **70 DN**	**8.5** **7**

Comparison of Humidity Levels

The chart below shows humidity trends in all houses that had a full year data set. There are nine trendlines, with three full sets of data over two years for two houses (NS78A and NS95 UP and DOWN). The trendlines for 2003/2004 are shown as dotted lines, while 2004/2005 are solid. The heavy dashed line shows the average humidity for Halifax and region on a monthly basis[11]. This chart shows the overall trend of higher humidity levels in the late fall than in the spring. It also shows the differences possible in yearly weather patterns, where the three trendlines for winter 2003 are convex, or nearly so, the five trendlines for four different houses are concave. This most likely indicates a wetter spring. In addition, the three trendlines for winter 2003 start off much higher than winter 2004, although they only refer to two houses. This could be attributed to the after effects of Hurricane Juan. Three of the five RH trend lines for 2004/2005 (B78A, B78B and B95DN) are very closely related throughout the monitoring period, and D68 varies from these three lines about 1/3 the way through the monitoring season (sometime in mid-January). The one trendline from 2004/2005 that is 'outstanding in it's field' is B95UP, and, just as it did in 2003/2004, this upper floor had consistently higher RH values than the main floor, however, it does mirror the curve of the main floor trendline (B95DN) quite handily.



[11] http://www.bbc.co.uk/weather/world/city_guides/results.shtml?tt=TT000860

The data from the BBC website is interesting, as it shows the average RH levels on a diurnal basis for each month.[12] The heavy dashed trendline in the preceding chart was generated using the figures from column 4 of the following table.

3.5.1.2 AVERAGE RH LEVELS FOR HALIFAX, BY MONTH

Month	RH AM	RH PM	RH Ave
Nov	84	71	77.5
Dec	80	68	74
Jan	82	69	75.5
Feb	81	63	72
Mar	77	60	68.5
Apr	76	60	68
May	76	62	69

As can be seen, the average humidity levels are higher in the fall than in the spring, and consistently higher during the 'AM' period. A diurnal swing in RH levels is seen generally in the field study houses, although day-to-day weather changes and site conditions (shadow lines, wind patterns, etc) also impact on the pattern. Where a daily pattern can be discerned, the RH level seems to rise during the late morning to mid-afternoon, when the sun may be full on the building, or when the temperature outside has perhaps reached it's daily peak. A second rise in RH is often seen overnight, especially when temperatures dip considerably from daytime highs. This means the RH is more or less 'stable' during the colder months of the year and more 'volatile' over the shoulder seasons, typically after the houses have been closed up and the six to eight weeks before they are opened up again.

[12] http://www.bbc.co.uk/weather/world/city_guides/results.shtml?tt=TT000860

3.6 Discussion

The study was an initial investigation into the vexing problem of musty seasonal dwellings. The work required was to carry out a survey of seasonal houses and general characteristics, then carry out field testing on a number of the houses identified in the survey. The goal was to find inexpensive ways to reduce or eliminate that musty smell from seasonal houses.

The survey caught the interest of 50 homeowners, mainly in eastern Canada, there were 38 survey submissions and twelve homeowners in Nova Scotia were enlisted to be part of the field study. Of these twelve, only ten ended up participating in the field study, which consisted of an EnerGuide for Houses evaluation and an indoor air quality evaluation. Recommendations were made to the eight homeowners and six homeowners carried out most or all of the recommendations made to them by the project team. Five houses were monitored over the course of two years.

The field study was disappointing in a few aspects. Firstly, the datalogger performance was not up to par, resulting in only two houses with full data sets (B78A and B95). Secondly, foundation problems were the major issues found in all houses that were investigated and/or monitored. Thirdly, homeowners were wary and/or reluctant to carry out recommendations that seemed unusual or costly.

Dataloggers are notorious for failing. The project team did everything in its power to ensure that the Oakton sensors would be operational, including changing batteries well within the useful lifespan, as well as checking on the houses half-way through the first year.

In most cases, mitigating foundation moisture problems helped to reduce the overall RH levels in the houses that were monitored. Anecdotally, the houses that were not monitored also have experienced an increase in air quality and a decrease in condensation, moisture and/or mold growth problems once the recommendations made by the project team were carried out. The recommendations made were all recognized solutions to ‘standard’ foundation moisture issues.

Solving foundation moisture problems is not glamourous or groundbreaking, or even surprising in Canadian housing. The fact that all houses in the field study had moisture problems that emanated from the foundation is a clear indication that seasonal homeowners could improve the indoor air quality and the lifespan of the buildings by attending to moisture problems in or around the foundation.

Repairing the damage done by moisture problems left unchecked can be more costly by far than dealing with the moisture problem itself. However, seasonal homes are often places to ‘get away’, and homeowners are

often loath to spend their hard-earned weekends and vacation time working on a house, or paying someone to do so. Homeowners in this study were unwilling to pay more than $200 or so on any given solution – including rental businesses. Only the owner of house B95 was willing to put more money into the cleanup project, as they were unable to use the house as it was.

The project team had hoped to be able to produce and monitor a series of interesting and innovative details and recommendations for mitigating moisture problems in seasonal homes. However, with the exception of one homeowner, study participants were unwilling to invest in a radical change or one that would increase operating costs. Suggestions for solar chimneys to pull sun-heated air out, although inexpensive, were not taken up with enthusiasm. While the concept of a solar chimney may be slightly out of most peoples' comfort zone, using humidistats on existing bathroom fans seemed to be more accessible. However, homeowners (including rental cottage owners) were not willing to pay for power over the winter. One homeowner installed a crawlspace ventilation system, but its effectiveness is unknown. The homeowner again was unwilling to keep the power on over the unoccupied season, and will only operate the ventilation system when the building is in use – so it didn't run over the second year monitoring period (neither did the datalogger for that matter). Not one homeowner in the study was interested in shutters, and there was even hesitation around the idea of using plastic wrap on windows to eliminate condensation, even as a part of the seasonal close-up.

In terms of the data analysis, a significant difference was seen in the RH trends over the two years of monitoring. The first year the houses were monitored and no recommendations were carried out; Nova Scotia was also recovering from Hurricane Juan. Whether or not Juan was responsible in large part for the much higher RH values in all houses in November and December 2003, those of November and December 2004 and, indeed, the whole second year are consistently lower and follow a different curve. This leads to the assumption that both 'normal' weather, along with the recommendations carried out, had some effect on the behaviour of the interior of the houses.

For the most part, key diurnal temperature patterns appear in November and from March on. These diurnal swings – highs above 10°C and lows approaching 0°C – are important in that they could lead to house interiors reaching saturation or dew point temperatures frequently over these months, especially in wet fall or spring conditions when RH levels are already high. March is noted as a month where this situation could occur on a daily basis, at least in Nova Scotia, as dew point temperatures are reached fairly quickly in times of high RH. April is, on the whole, warmer than March, without the below-zero overnight/early morning temperatures, and there is a general trend to slightly lower RH levels. This means less chance of 'saturation' events in April.

Diurnal patterns in RH levels follow a generally recognizable trend of rising in the late morning to mid-afternoon, and again in the late evening. Weather events such as rainstorms and spring freeze-thaw cycles influence the RH levels, as it seems, do seasonal shifts in shadowing patterns from surrounding obstacles.

The anticipated opposing pattern of temperature decrease/RH increase was not consistently apparent throughout all of the monitored houses, however it was seen, mainly through the shoulder seasons when there was a more pronounced change in above-zero temperatures.

Packing bed linens, blankets and pillows in airtight containers can reduce musty smells. Upholstered furniture and mattresses left to overwinter should be kept to a minimum, as should paper items. The project team recognizes that removing all permeable items is not a permanent solution to moisture issues, but only a temporary way of addressing musty smells.

A simple way of reducing condensation issues around windows (which is where most condensation problems occur) is to simply install plastic film over the windows. As part of the 'close up' routine, this small chore could be of great benefit, especially in rental units that are cleaned thoroughly at the end of a tenant's occupancy in anticipation of the next renter. This gives homeowners and landlords the chance to reduce the time spent (and money spent, in the case of landlords and cottage rental businesses) cleaning and 'airing out' when the house is opened up again. Suggesting that homeowners replace single pane glazing with high-performance units in a seasonal home is not a practical solution, given that the rest of the structure typically would need to be thermally improved as well. However, for upscale second homes and long-term rental units, improved glazing may be viable.

If homeowners were willing to keep power on for those times of year where high humidity and temperature swings from 10°C to 0°C, then humidistats on exhaust fans would be a viable option to eliminate potential 'saturation' events. For an initial investment of ±$200, including installation, a humidistat would add minimal cost to annual operating expenses, as it would only run the fan for short periods at preset RH levels.

It would seem that – all things being equal –homeowners could use one or more of the inexpensive options outlined above as a way of mitigating RH levels and 'saturation events' over the shoulder seasons, thereby reducing or even possibly eliminating musty smells, condensation and mold issues. Certainly dealing with moisture issues arising from physical defects such as foundation problems, poor drainage and lack of eavestroughing would go a long way to improve indoor air quality in seasonally occupied housing.

4 Conclusions

In this small sample of seasonal houses in Nova Scotia, most of the moisture problems related to damp foundation conditions. The project team recommended standard, proven fixes to moisture problems in foundations. These straightforward fixes were carried out by homeowners, provided there was not a large cost associated with them.

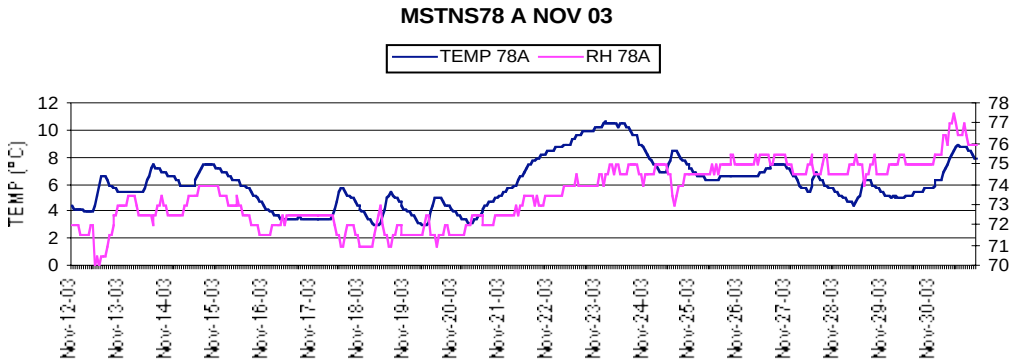
There was some success in mitigating moisture problems in the field study houses.

APPENDICES

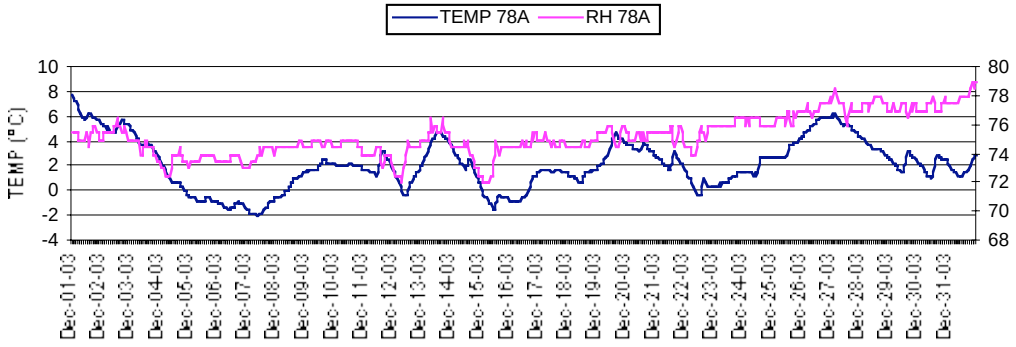
5 Field Study Data

5.1 First Year

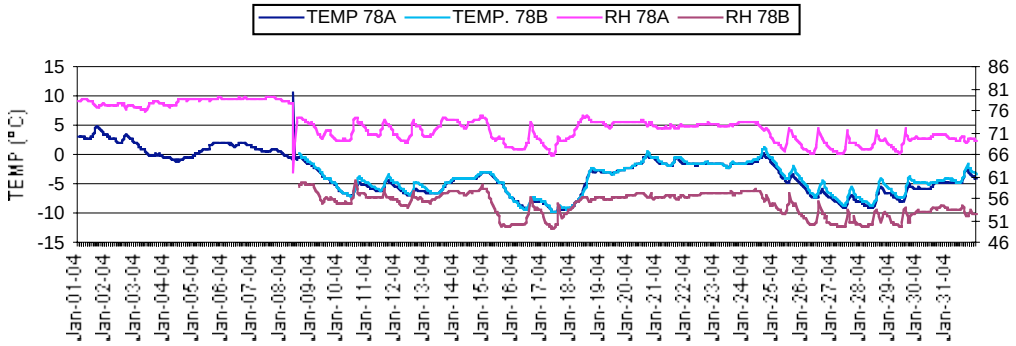
5.1.1 Weatherized Cottages MSTNSB78A and MSTNSB78B



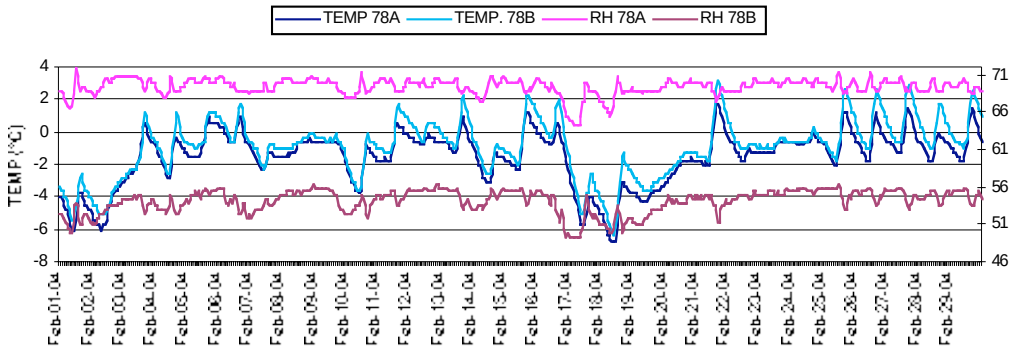
MSTNS78 A DEC 03

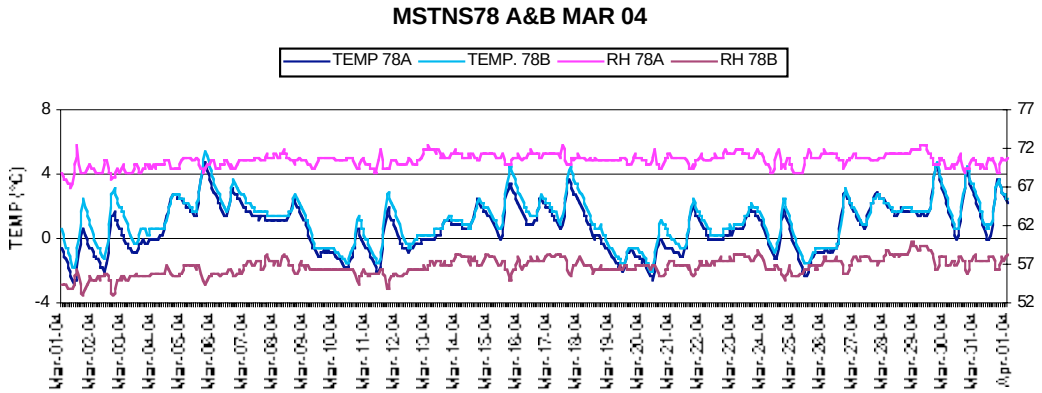


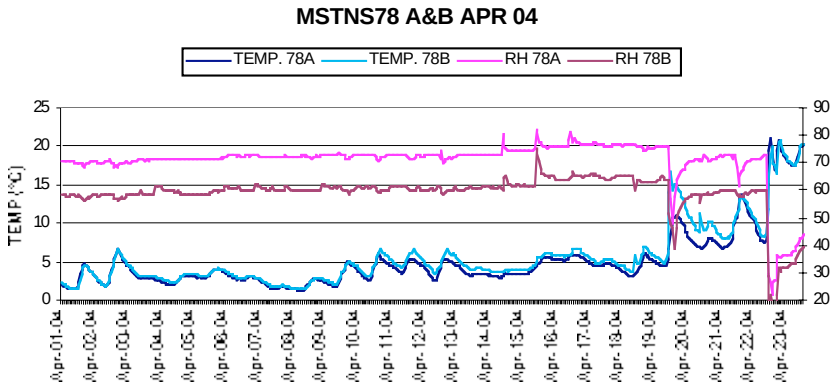
MSTNS78 A&B JAN 04



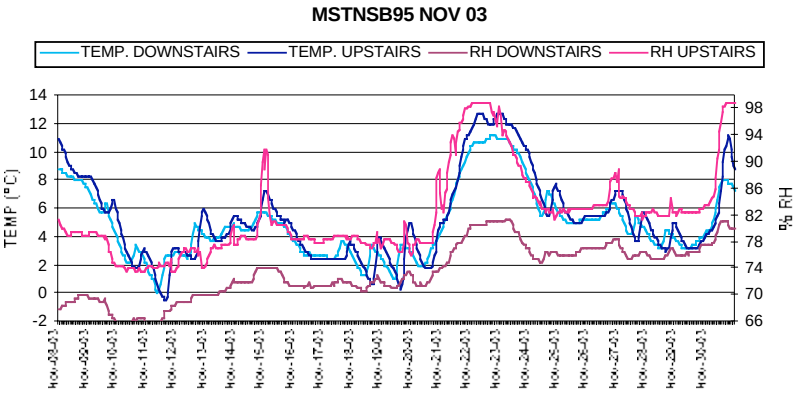
MSTNS78 A&B FEB 04



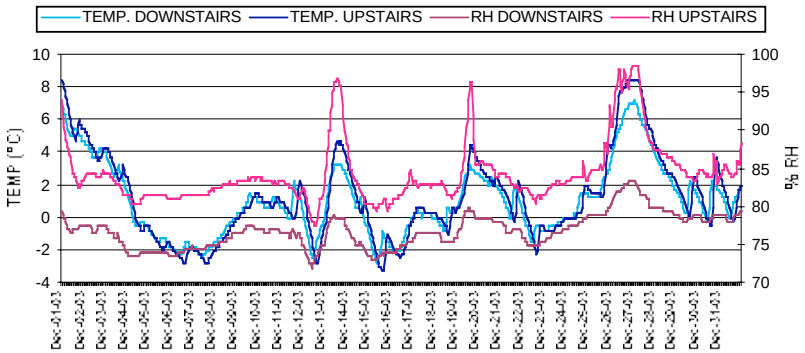




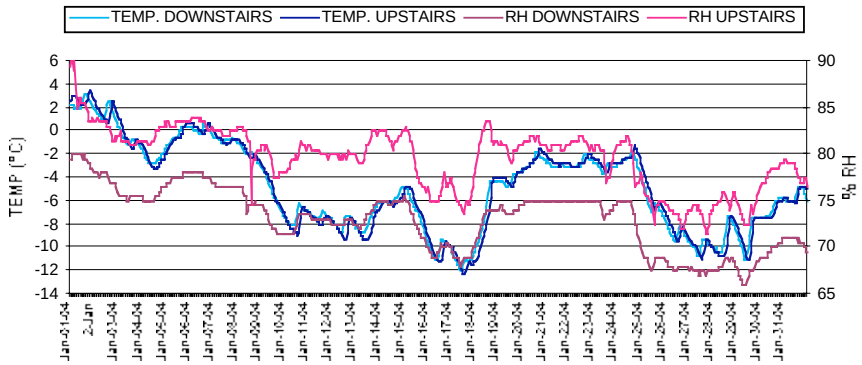
5.1.2 Weatherized Cottage MSTNSB95



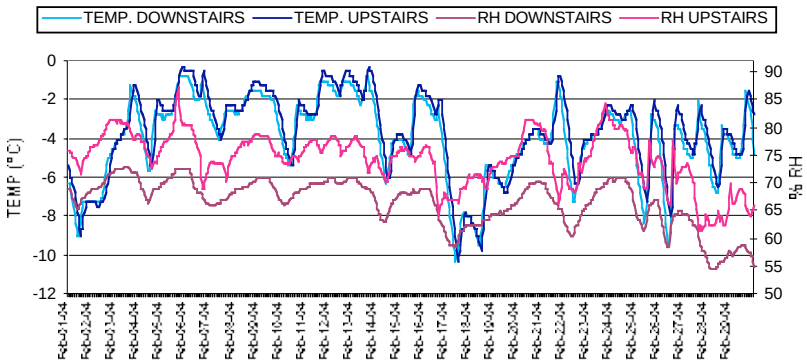
MSTNSB95 DEC 03



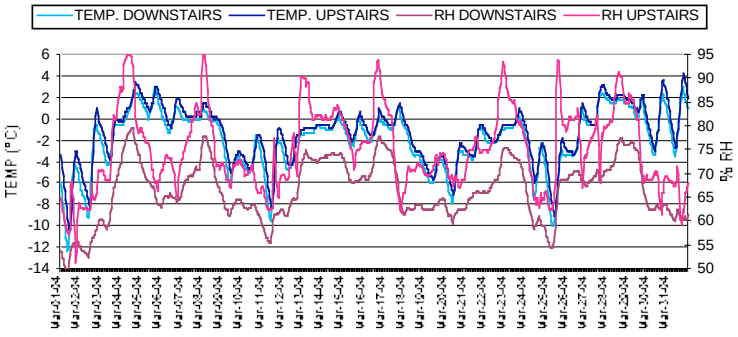
MSTNS95 JAN 04



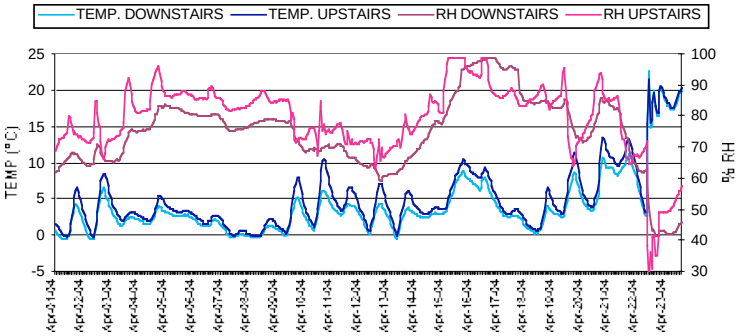
MSTNS95 FEB 04



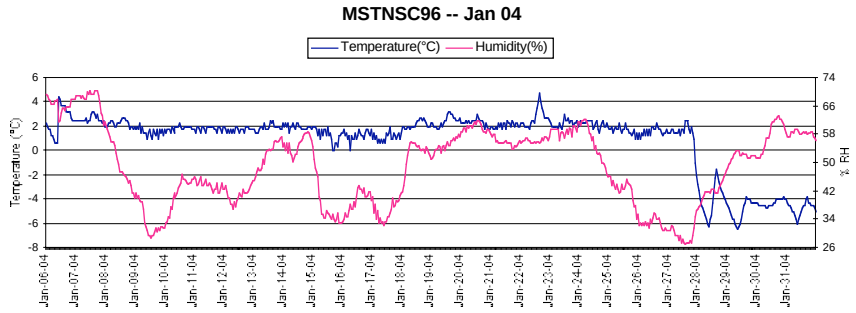
MSTNS95 MAR 04

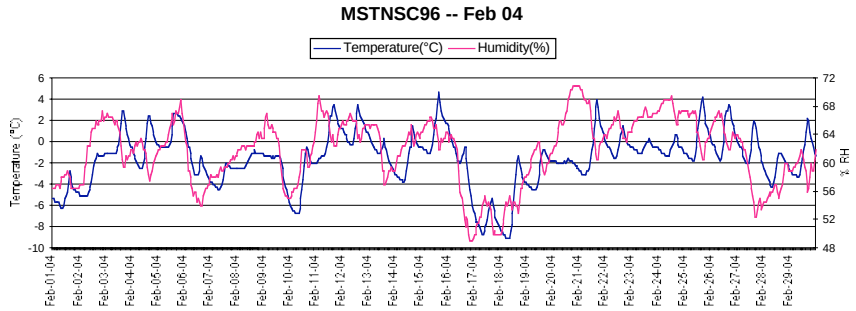


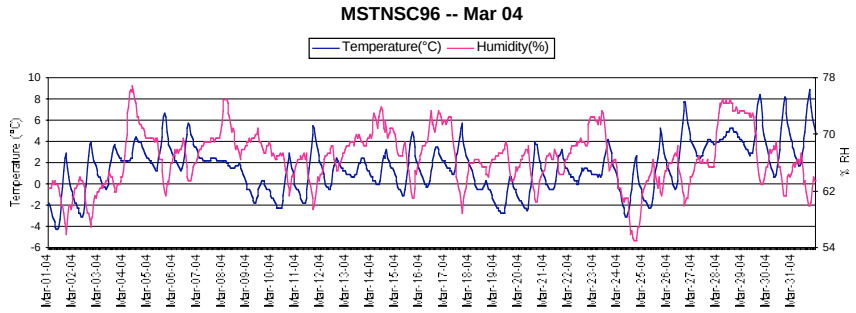
MSTNS95 APR 04

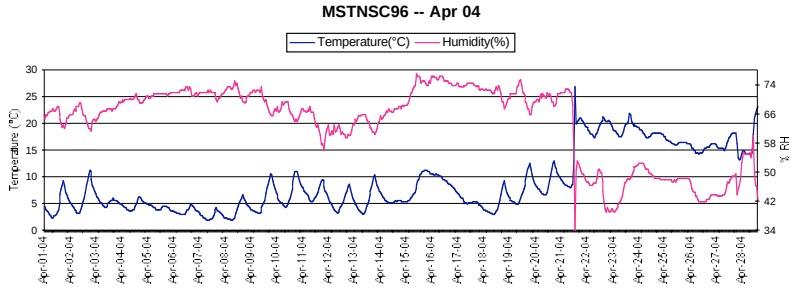


5.1.3 Uninsulated House MSTNSC96



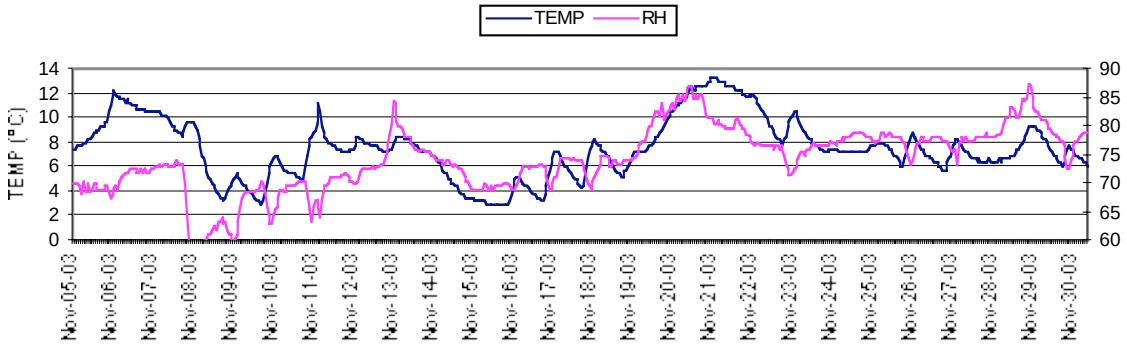




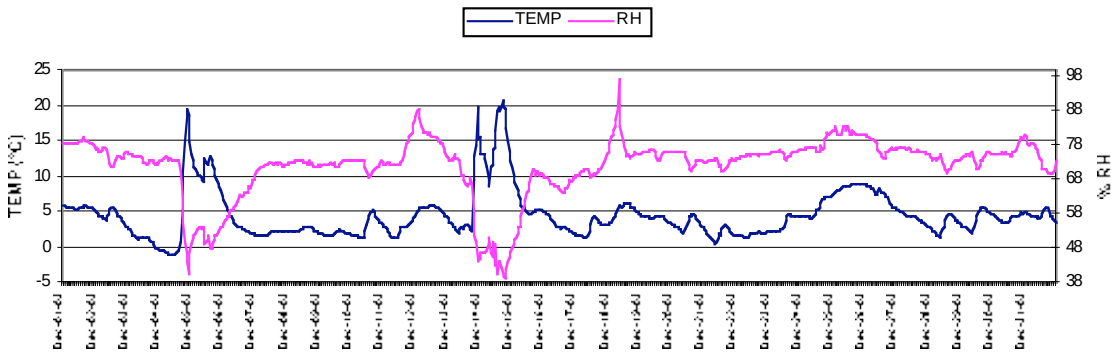


5.1.4 Weatherized House MSTNSD68

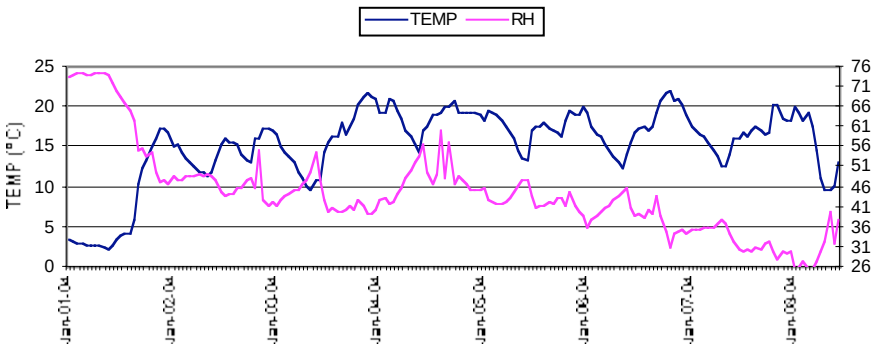
MSTNSD68 NOV 03



MSTNSD68 DEC 03

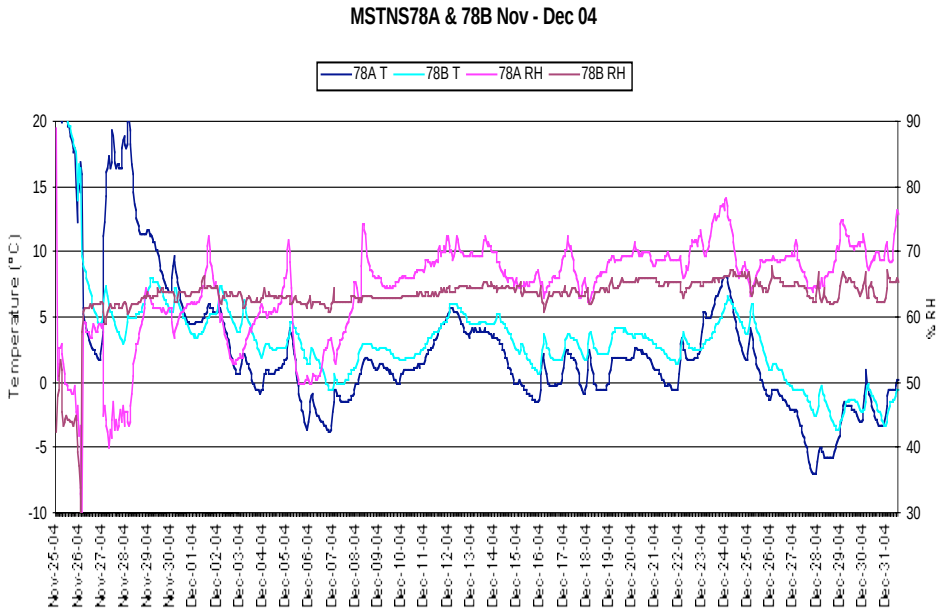


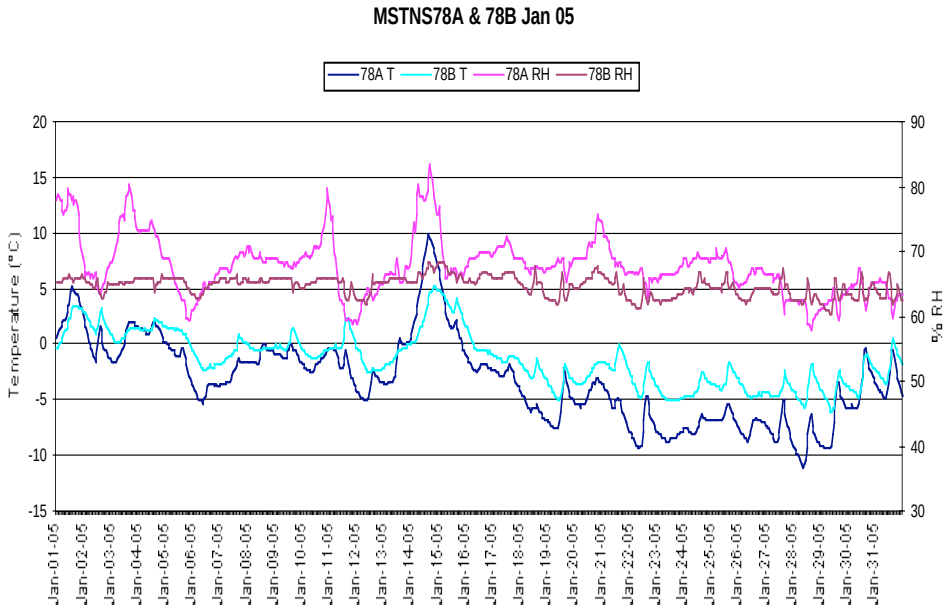
MSTNSD68 JAN 04



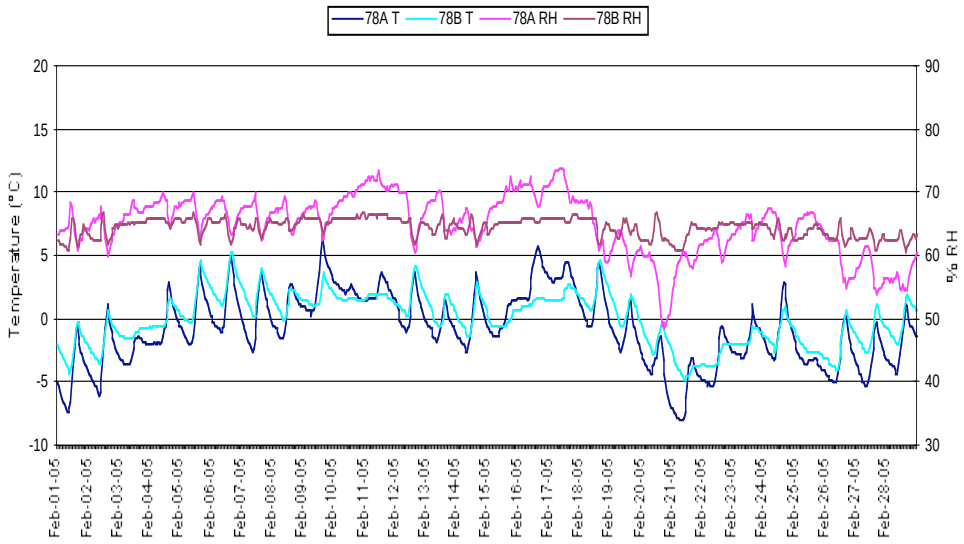
5.2 Field Study Data, Second Year

5.2.1 Weatherized Cottages MSTNSB78A & 78B

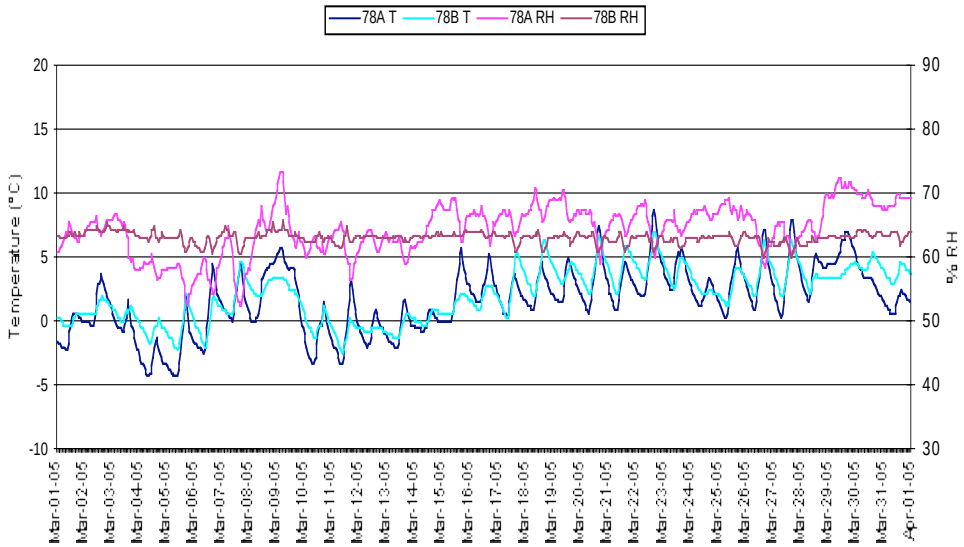


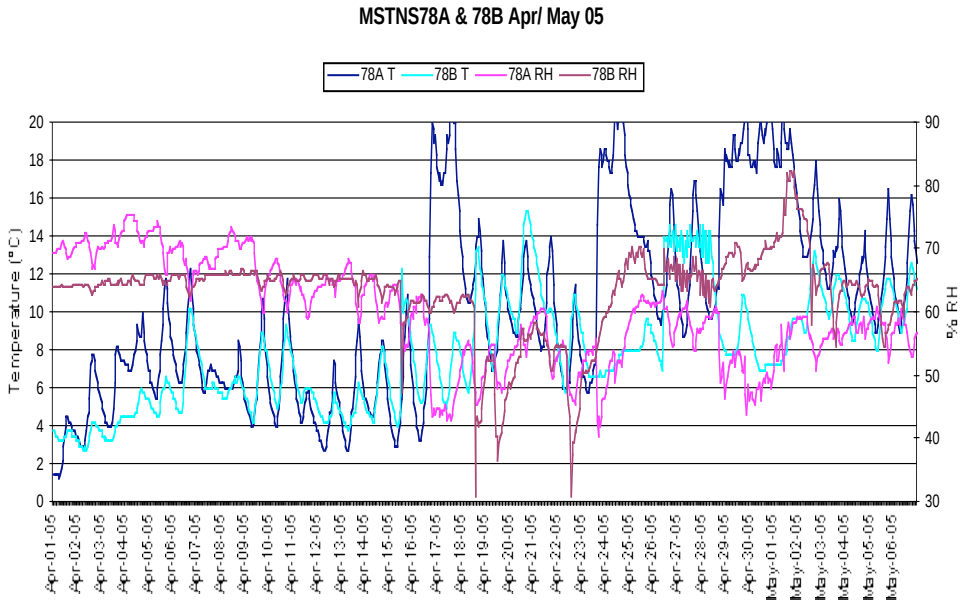


MSTNS78A & 78B Feb 05

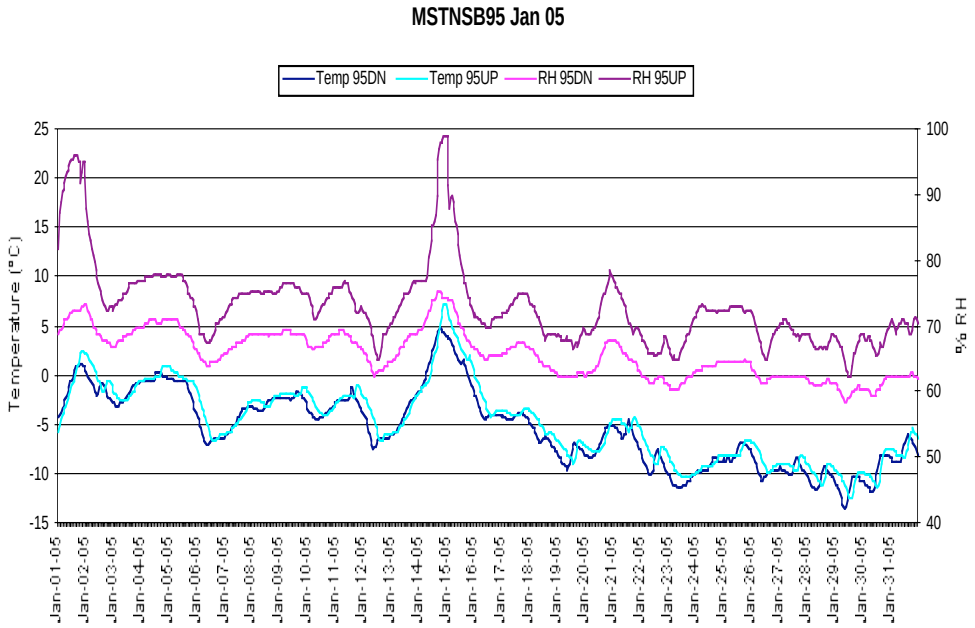


MSTNS78A & 78B Mar 05

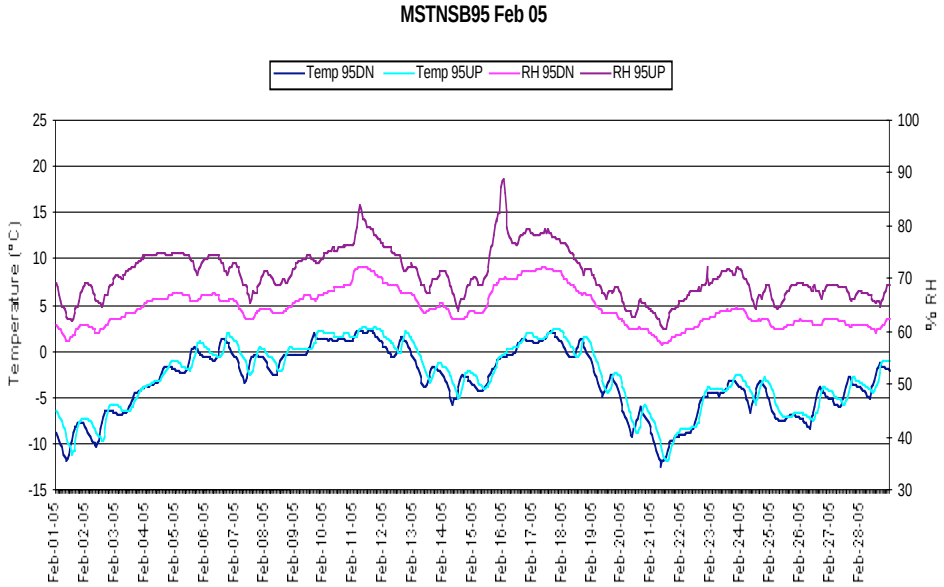



MSTNS78A & 78B Apr/ May 05
78A T
78B T
78A RH
78B RH
Temperature (°C)
% RH
0
2
4
6
8
10
12
14
16
18
20
30
40
50
60
70
80
90
Apr-01-05
Apr-02-05
Apr-03-05
Apr-04-05
Apr-05-05
Apr-06-05
Apr-07-05
Apr-08-05
Apr-09-05
Apr-10-05
Apr-11-05
Apr-12-05
Apr-13-05
Apr-14-05
Apr-15-05
Apr-16-05
Apr-17-05
Apr-18-05
Apr-19-05
Apr-20-05
Apr-21-05
Apr-22-05
Apr-23-05
Apr-24-05
Apr-25-05
Apr-26-05
Apr-27-05
Apr-28-05
Apr-29-05
Apr-30-05
May-01-05
May-02-05
May-03-05
May-04-05
May-05-05
May-06-05

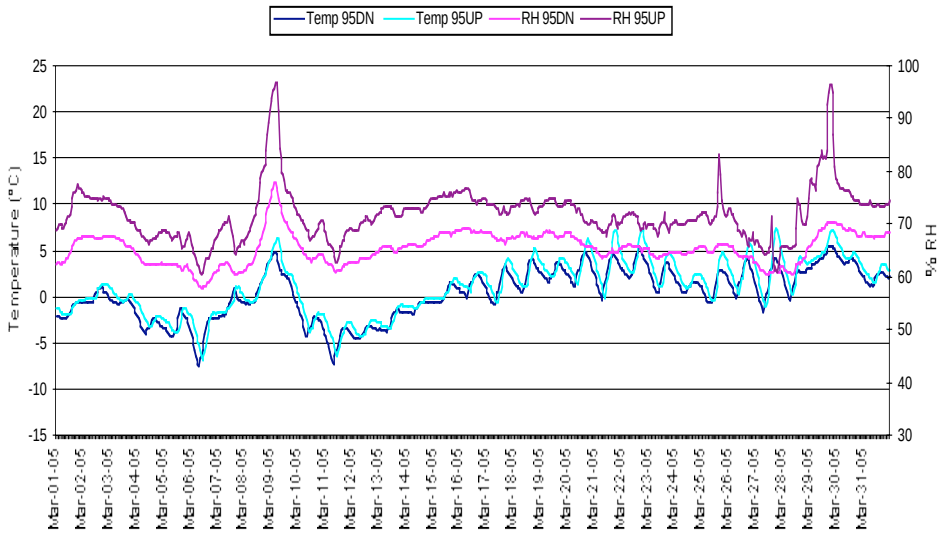
5.2.2 *Weatherized Cottage*



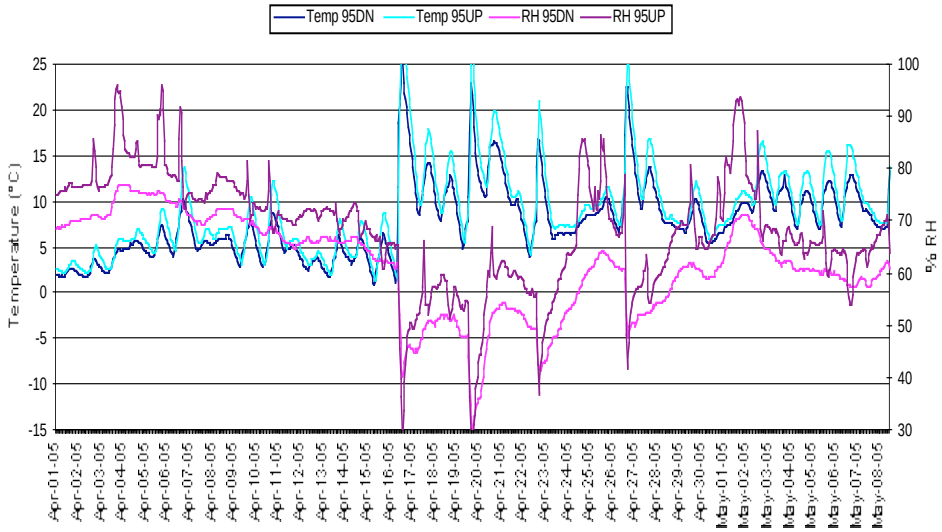
MSTNSB95



MSTNSB95 Mar 05



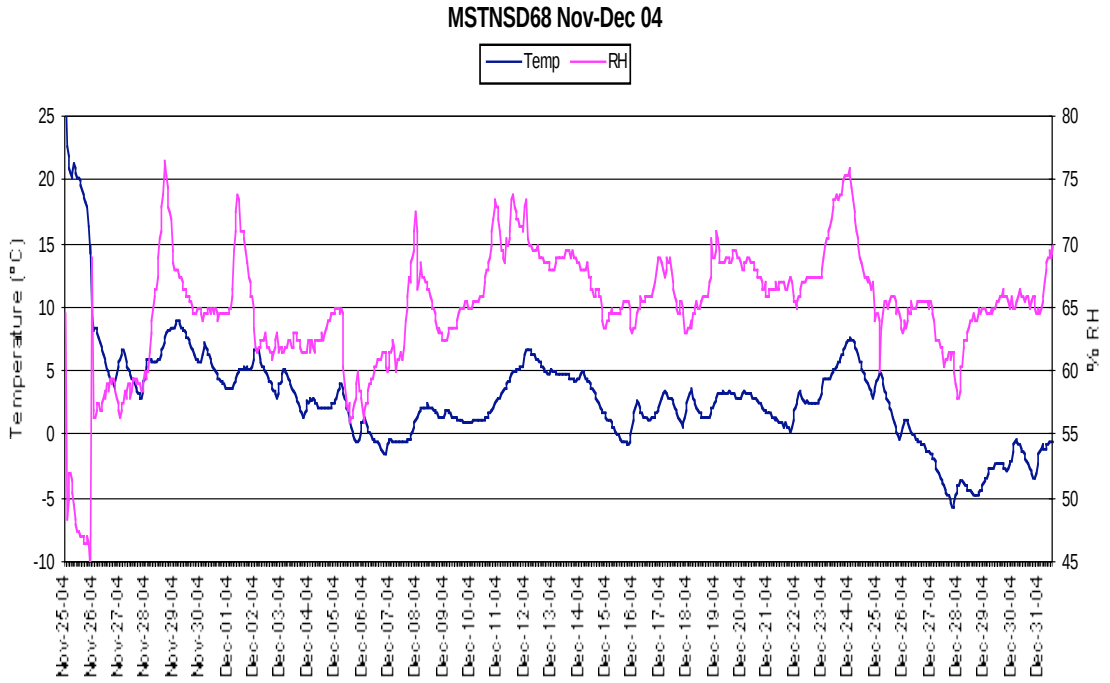
MSTNSB95 Apr-May 05

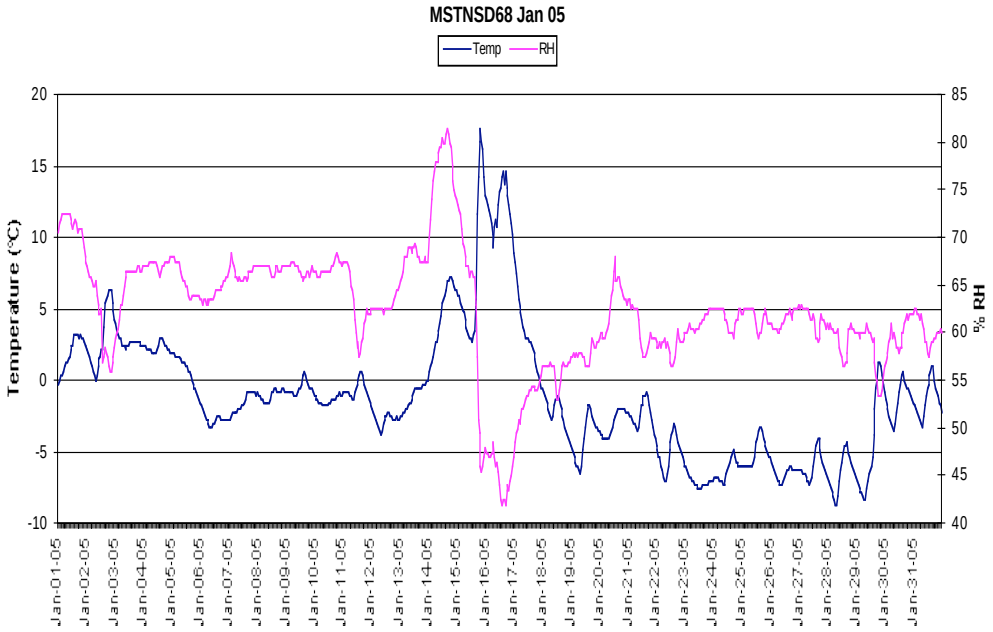


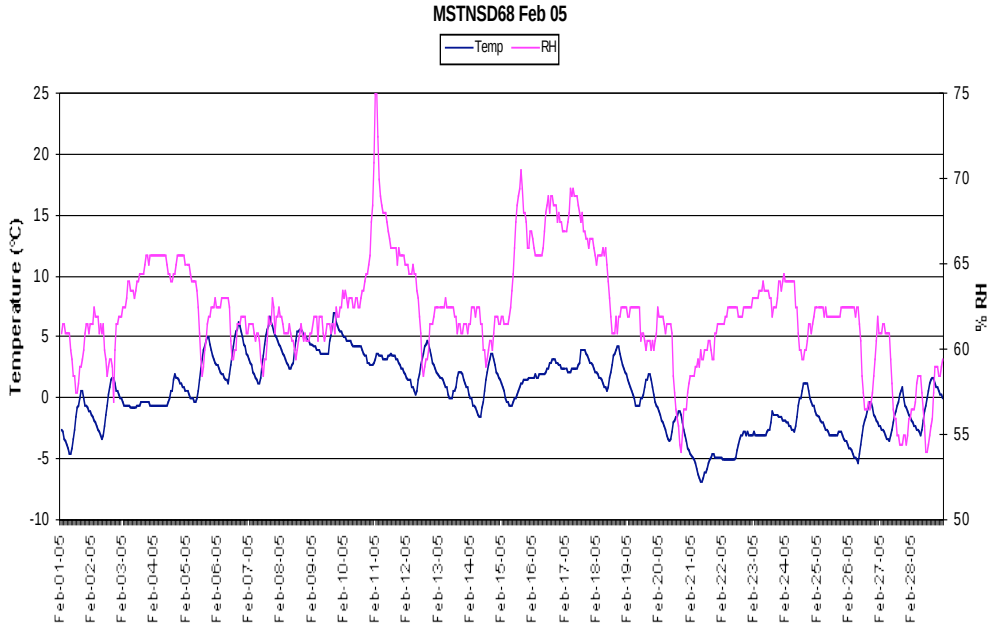
5.2.3 Uninsulated House MSTNSC96

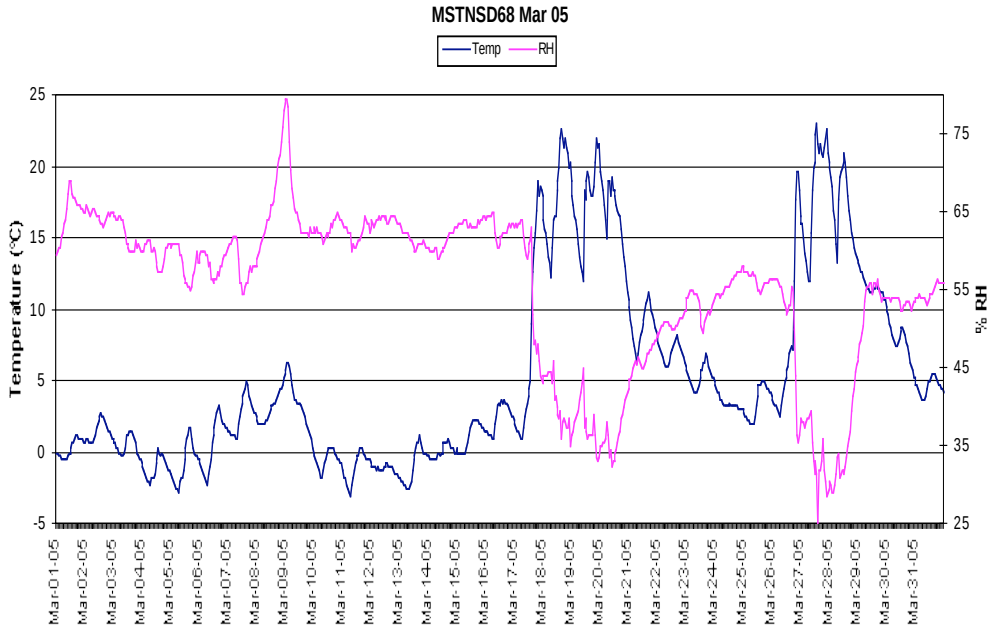
DATALOGGER FAILURE

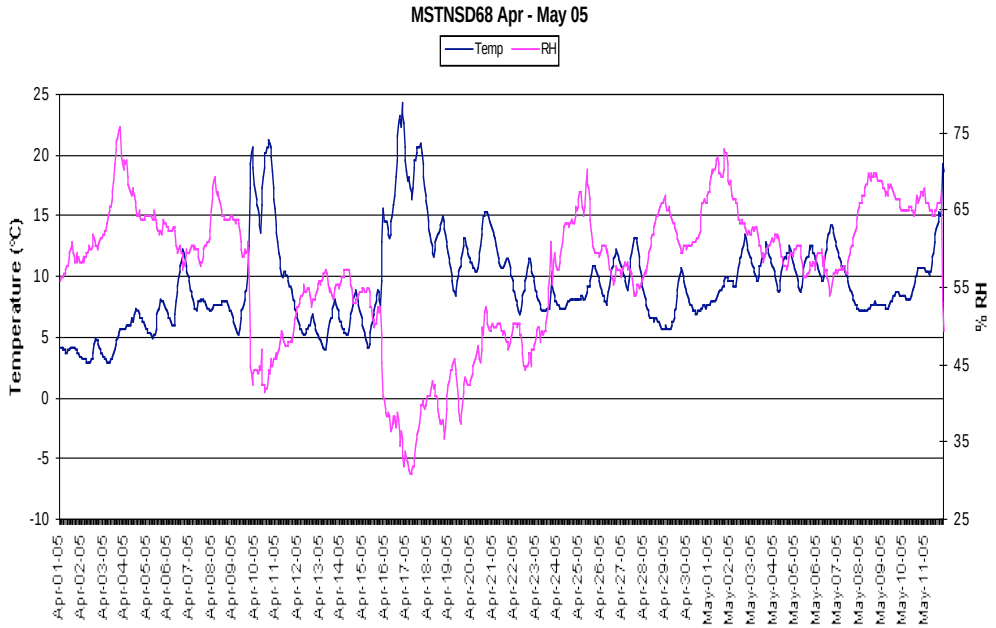
5.2.4 *Weatherized House MSTNSD68*






MSTNSD68 Feb 05
Temp
RH
Temperature (°C)
% RH
25
20
15
10
5
0
-5
-10
75
70
65
60
55
50
Feb-01-05
Feb-02-05
Feb-03-05
Feb-04-05
Feb-05-05
Feb-06-05
Feb-07-05
Feb-08-05
Feb-09-05
Feb-10-05
Feb-11-05
Feb-12-05
Feb-13-05
Feb-14-05
Feb-15-05
Feb-16-05
Feb-17-05
Feb-18-05
Feb-19-05
Feb-20-05
Feb-21-05
Feb-22-05
Feb-23-05
Feb-24-05
Feb-25-05
Feb-26-05
Feb-27-05
Feb-28-05


MSTNSD68 Mar 05
Temp
RH
Temperature (°C)
% RH
25
20
15
10
5
0
-5
75
65
55
45
35
25
Mar-01-05
Mar-02-05
Mar-03-05
Mar-04-05
Mar-05-05
Mar-06-05
Mar-07-05
Mar-08-05
Mar-09-05
Mar-10-05
Mar-11-05
Mar-12-05
Mar-13-05
Mar-14-05
Mar-15-05
Mar-16-05
Mar-17-05
Mar-18-05
Mar-19-05
Mar-20-05
Mar-21-05
Mar-22-05
Mar-23-05
Mar-24-05
Mar-25-05
Mar-26-05
Mar-27-05
Mar-28-05
Mar-29-05
Mar-30-05
Mar-31-05


MSTNSD68 Apr - May 05
Temp
RH
Temperature (°C)
% RH
25
20
15
10
5
0
-5
-10
75
65
55
45
35
25
Apr-01-05
Apr-02-05
Apr-03-05
Apr-04-05
Apr-05-05
Apr-06-05
Apr-07-05
Apr-08-05
Apr-09-05
Apr-10-05
Apr-11-05
Apr-12-05
Apr-13-05
Apr-14-05
Apr-15-05
Apr-16-05
Apr-17-05
Apr-18-05
Apr-19-05
Apr-20-05
Apr-21-05
Apr-22-05
Apr-23-05
Apr-24-05
Apr-25-05
Apr-26-05
Apr-27-05
Apr-28-05
Apr-29-05
Apr-30-05
May-01-05
May-02-05
May-03-05
May-04-05
May-05-05
May-06-05
May-07-05
May-08-05
May-09-05
May-10-05
May-11-05

6 House Characteristics

6.1 House Types and Foundations

House File #	MSTNSD68	0MSONC69	MSTONA70	MSTONC71	MSTNSD72	MSTNSA73	MSTOND74	MSTNSB76	MSTNSB78 A	MSTNSB78 B	MSTONB79	MSTNSD80	MSTNSA81	MSTNSA82	MSTNSB83	MSTONA84	MSTNSD85	MSTNSD86	MSTNSD87	MSTNSA88	MSTNBD89	MSTNSB90	MSTNSC91	MSTNSD92	MSTNSB93	MSTNSB94	MSTBNS95	MSTNSC96	MSTNBD97	MSTNSB98	MSTNAS99	MSTNSD100	MSTNSB101	MSTMBD102
House Type																																		
Uninsulated cottage			●			●							●	●		●				●											●			
Weatherized cottage								●	●	●	●				●							●			●	●	●			●			●	
Uninsulated house		●		●																			●					●						
Weatherized house	●				●		●					●					●	●	●		●			●					●			●		●
Foundation Type																																		
Pole foundation								●									●																	
Open crawlspace			●								●		●														●				●			
Closed crawlspace				●					●	●					●					●					●			●	●	●				
Slab-on-grade														●								●												
Shallow basement						●													●				●											
Full basement	●	●			●											●		●			●			●		●							●	
Foundation Insulation																																		
Yes					●				●	●						●																		
No	●	●	●	●			●	●			●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Stone	●	●		●											●								●	●							●			
Concrete block			●			●					●										●				●			●					●	
Poured Concrete					●				●	●						●	●	●	●	●		●				●	●			●				
Wood								●						●															●					
PTW													●																					
ICF																																		

6.2 Age of Houses in Survey, Sorted by Province

Province/ Date	File #
MANITOBA	
unknown	MSTMBD102
NEW BRUNSWICK	
1960s	MSTNBD89
1970s	MSTNBD97
NOVA SCOTIA	
1860s	MSTNSD68
	MSTNSC91
	MSTNSD92
1930s	MSTNSB98
1940s	MSTNSA73
	MSTNSC96
1950s	MSTNSA81
	MSTNSB83
	MSTNSA88
	MSTNSB93
	MSTNSB101
1960s	MSTNSA82
	MSTNSA99
1970s	MSTNSD72
	MSTNSB90
	MSTNSB94
1980s	MSTNSD85
	MSTNSD86
	MSTNSB95
1990s	MSTNSB76
	MSTNSD87
2000s	MSTNSB78A
	MSTNSB78B
unknown	MSTNSD80
	MSTNSD100
ONTARIO	
1860s	MSTONC71
1900s	MSTONC69
1930s	MSTONA84
1960s	MSTONA70
1980s	MSTONB79
unknown	MSTOND74

6.3 Building Location & Window Characteristics

House File #	MSTNSD68	0MSONC69	MSTONA70	MSTONC71	MSTNSD72	MSTNSA73	MSTOND74	MSTNSB76	MSTNSB78A	MSTNSB78B	MSTONB79	MSTNSD80	MSTNSA81	MSTNSA82	MSTNSB83	MSTONA84	MSTNSD85	MSTNSD86	MSTNSD87	MSTNSA88	MSTNBD89	MSTNSB90	MSTNSC91	MSTNSD92	MSTNSB93	MSTNSB94	MSTBNS95	MSTNSC96	MSTBNS97	MSTNSB98	MSTNSA99	MSTNSD100	MSTNSB101	MSTMBD102
Buidling Location																																		
Close to lake			●											●	●		●	●				●	●		●									
Close to ocean					●			●	●	●			●							●						●		●		●			●	
Close to river																			●								●				●	\		
Close to seasonal stream																													●					
Close to year-round stream						●															●													
In a forest clearing				●							●					●								●										
In a field	●	●																																
Proximity to waterbody (m)	400	200	8	150	800	6		30	450	450	N/A		100	20	30	30	7	35	15	20	40	10	400	N/A	45	30	15	20	15	200	180		400	
Window Orientations																																		
Any South or West facing glazing?	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Main orientation of windows	SE	W	ALL	SW	N	NE		ALL	SW	SW	W		SW	SE	W	W	ALL	ALL	E	N	S	E	SE	NE	ALL	SE		N	N	SW	N		NW	
% Main orientation		65	50	35	10	50		50	50	50	20		60		20	60	30	40	20	50	40	35		60	10		40	35	20	50	60		50	
Shutters?	SE	SE			SE			ALL	SE	SE	SE		ALL	SE	SE	N	SE	SE		SE	SE	SE	NW	SE		SE				SE	SE			
Awnings?		ALL			SE				SE	SE	SE			SE	SE			SE								SE			SW	SW				

6.4 Mold & Condensation Characteristics

House File #	MSTNSD69	MStONC69	MSTONA70	MSTONC71	MSTNSD72	MSTNSA73	MSTOND74	MSTNSB76	MSTNSB78A	MSTNSB78B	MSTONB79	MSTNSD80	MSTNSA81	MSTNSA82	MSTNSB83	MSTONA84	MSTNSD85	MSTNSD86	MSTNSD87	MSTNSA88	MSTNBD89	MSTNSB90	MSTNSC91	MSTNSD92	MSTNSB93	MSTNSB94	MSTNSB95	MSTNSC96	MSTNSB97	MSTNSB98	MSTNSA99	MSTND100	MSTNSB101	MSTMBD102
Do you air out the house at the beginning of the season?																																		
Uninsulated cottage													●	●		●														●				
Weatherized cottage									●	●	●											●			●		●		●					
Uninsulated house																							●					●						
Weatherized house	●																	●			●			●										
Have you observed mold in the house when you first open it for the season?																																		
Uninsulated cottage						●								●																				
Weatherized cottage									●	●																●	●		●					
Uninsulated house		●		●																			●					●						
Weatherized house	●				●													●	●															
Have you observed mold in the house during the season of use?																																		
Uninsulated cottage																																		
Weatherized cottage																											●			●				
Uninsulated house				●																														
Weatherized house																			●		●													
Have you ever cleaned mold out of the house?																																		
Uninsulated cottage														●																				
Weatherized cottage									●	●	●				●												●		●	●				
Uninsulated house		●		●																			●					●						
Weatherized house	●				●												●	●	●		●													
Have you ever had standing water in the dwelling?																																		
Uninsulated cottage						●							●			●				●														
Weatherized cottage																																	●	
Uninsulated house		●																									●							
Weatherized house																		●	●		●													
Have you ever seen evidence of water leakage into the dwelling?																																		
Uninsulated cottage			●			●							●	●		●									●						●			
Weatherized cottage								●	●	●	●				●							●			●	●							●	
Uninsulated house		●																					●					●						
Weatherized house	●																●	●	●		●			●										
Have you had problems with condensation on the windows?																																		
Uninsulated cottage			●																															
Weatherized cottage									●	●	●														●		●							
Uninsulated house		●		●																								●		●			●	
Weatherized house	●				●												●	●	●		●			●					●					

6.5 Heating & Ventilation Characteristics

House File #	MSTNSD68	0MSONC69	MSTONA70	MSTONC71	MSTNSD72	MSTNSA73	MSTOND74	MSTNSB76	MSTNSB78	MSTNSB78B	MSTONB79	MSTNSD80	MSTNSA81	MSTNSA82	MSTNSB83	MSTONA84	MSTNSD85	MSTNSD86	MSTNSD87	MSTNSA88	MSTNBD89	MSTNSB90	MSTNSC91	MSTNSD92	MSTNSB93	MSTNSB94	MSTBNS95	MSTNSC96	MSTBNS97	MSTNSB98	MSTNSA99	MSTNSD10	MSTNSB101	MSTMBD10
Primary Heating System																																		
None							●					●		●					●				●							●				
Electric Baseboard				●					●	●	●				●					●	●	●				●								
Electric Furnace																																		
Oil Furnace																							●				●							
Oil Boiler					●																													
Gas/Prop. Furnace																								●						●		●		
Gas/Prop. Boiler																																		
EPA woodstove			●					●								●	●	●										●						
non-EPA woodstove	●	●																																
Open fireplace													●																					
Fireplace Insert																																		
Pellet Stove																																		
Oil Stove																																		
Other						●																				●								
Secondary Heating System																																		
None			●	●	●	●	●	●	●	●		●	●	●	●			●				●	●	●			●		●	●	●			
Electric Baseboard																	●		●						●									
Electric Furnace																																		
Oil Furnace																																		
Oil Boiler																																		
Gas/Prop. Furnace																																		
Gas/Prop. Boiler																																		
EPA woodstove																				●						●								
non-EPA woodstove																											●							
Open fireplace		●									●																							
Fireplace Insert																																	●	
Pellet Stove																																		
Oil Stove																																		
Other	●															●					●													
Ventilation System																																		
None	●	●	●	●		●	●	●				●	●	●		●	●	●		●		●	●	●	●	●	●	●	●	●	●			
Bath/Kit Exhaust									●	●	●								●															
Central Exhaust																																		
Air Exchanger					●																●												●	
HRV															●																			

6.6 Phone & Power Characteristics

House File #	MSTNSD68	0MSONC69	MSTONA70	MSTONC71	MSTNSD72	MSTNSA73	MSTOND74	MSTNSB76	MSTNSB78A	MSTNSB78B	MSTONB79	MSTNSD80	MSTNSA81	MSTNSA82	MSTNSB83	MSTONA84	MSTNSD85	MSTNSD86	MSTNSD87	MSTNSA88	MSTNBD89	MSTNSB90	MSTNSC91	MSTNSD92	MSTNSB93	MSTNSB94	MSTBNS95	MSTNSC96	MSTBNS97	MSTNSB98	MSTNSA99	MSTNSD100	MSTNSB101	MSTMBD102
Power Availability																																		
None	●							●																			●							
Seasonal (Utility)		●	●			●			●	●			●	●		●		●		●		●		●	●	●					●		●	
Year Round (Utility)				●	●						●				●		●		●		●		●					●	●	●				
Site Generated						●			●	●																								
Phone Line Availability																																		
Yes	●		●	●	●				●	●	●				●	●	●	●	●			●	●	●	●		●	●			●			

7 Two Proposed Recommendations

PROTOTYPE SOLAR VENT

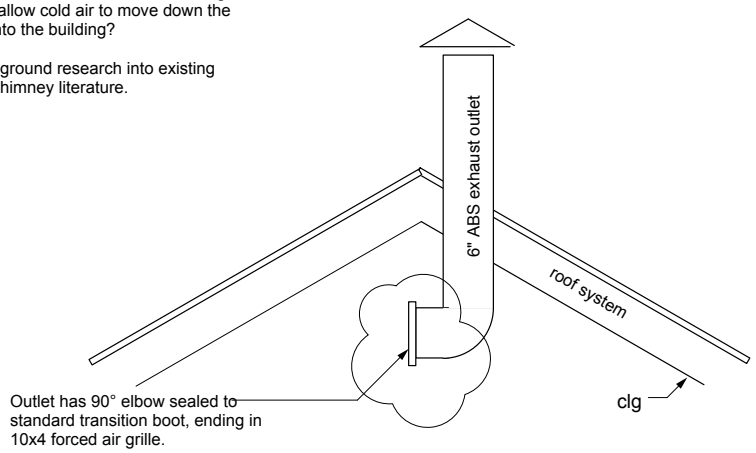
Premise: heated air will gather at the peak of a building, and that heated air will, if given a pathway, rise out of the building. A poly sheet hung behind a grille in an exhaust vent should be lifted from vertical when the chimney effect becomes strong (ie, when there is heated air in the peak). This should ventilate the building, taking moist, hot air out, and reducing condensation.

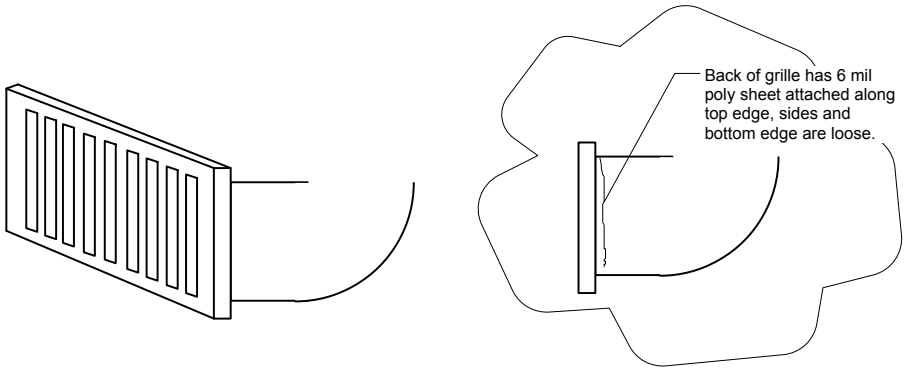
.

Issues:
How is the amount of air required to exhaust the house determined? Based on temperature difference, humidity difference?
What diameter should the exhaust outlet pipe be? And should it be based on the volume of the building?
What is the optimum grille size? Based again on volume of building?
Will 6 mil poly suffice?
How to ensure that the poly does not get caught up in the ABS and therefore vent the building constantly, or allow cold air to move down the exhaust and into the building?

Requires background research into existing solar cooling chimney literature.

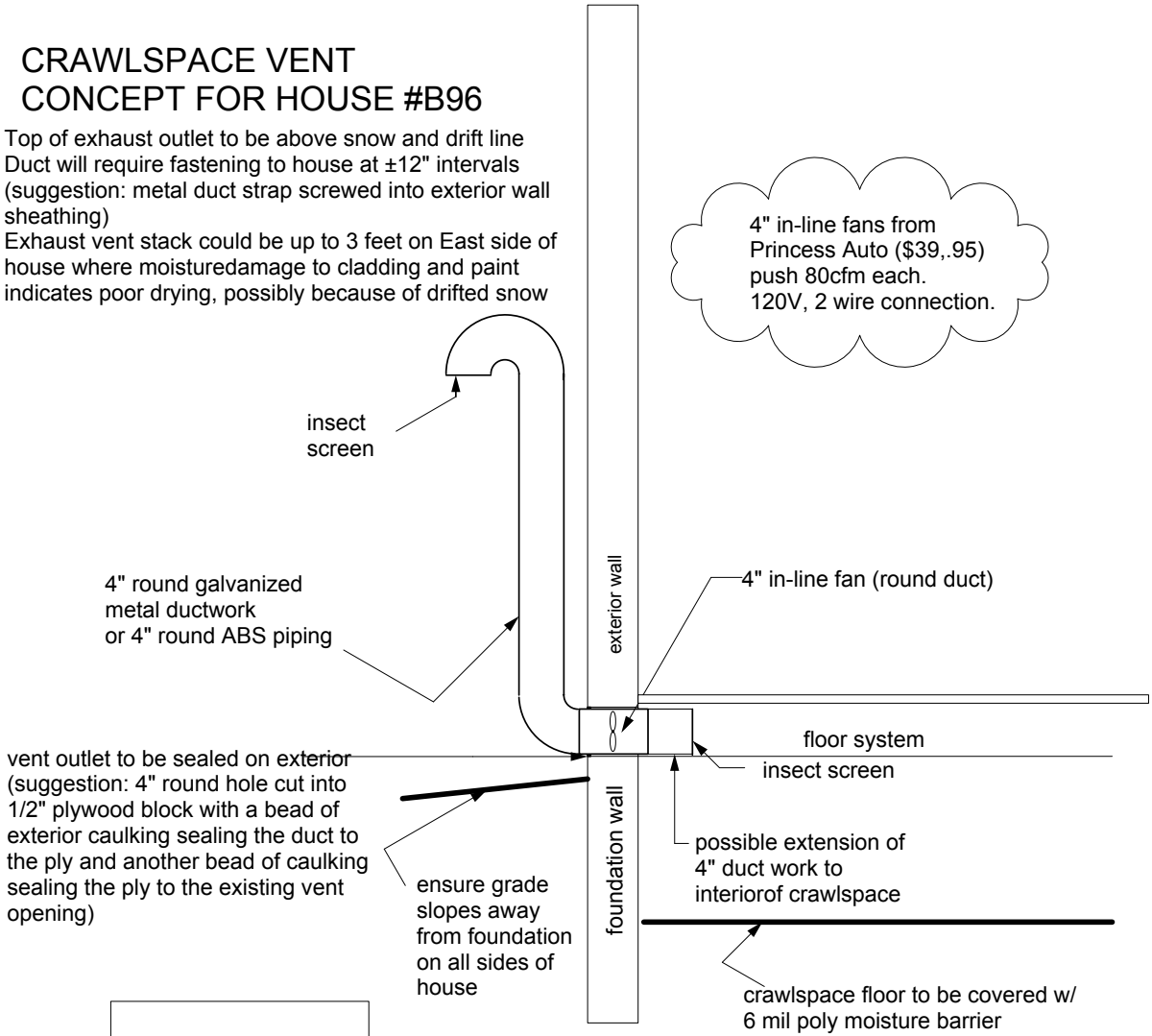
Exhaust outlet to be within 12" of highest interior point.
Exhaust outlet to be 6" black ABS pipe, to take advantage of any extra solar gain available.
Top of exhaust outlet to be 24" above peak to maximize 'chimney effect'.
Exhaust outlet to have screen (1/4" wire mesh) and weather guard.

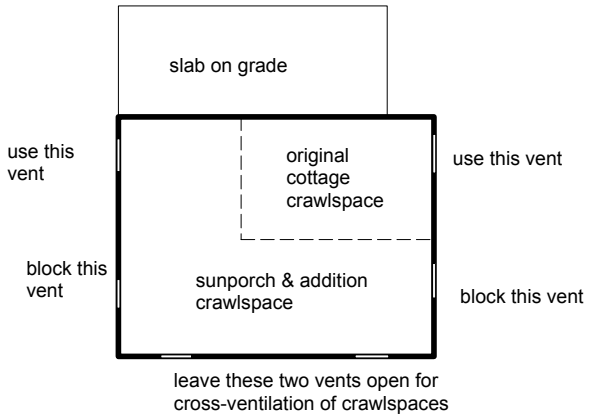




CRAWLSPACE VENT CONCEPT FOR HOUSE #B96

Top of exhaust outlet to be above snow and drift line
Duct will require fastening to house at ±12" intervals (suggestion: metal duct strap screwed into exterior wall sheathing)
Exhaust vent stack could be up to 3 feet on East side of house where moisturedamage to cladding and paint indicates poor drying, possibly because of drifted snow





Install one at each of the vents closest to the slab on the East and West sides, seal off the two E/W vents closest to the sunporch and keep the two, more elevated, vents at the sunporch open for adequate cross-ventilation of crawlspaces.

Test to ensure the fans are actually pulling air out of the crawlspaces. If not, block off one or a portion of the sunporch vents to ensure adequate airflow. Crawlspaces do not have to be depressurized, only ventilated to min. 50 cfm for this volume.

8 Survey

This housing research project is being conducted for Canada Mortgage and Housing Corporation (CMHC) by Abri Sustainable Design & Consulting. If you have any questions or would like more information, please call 1.902.489.1014.
We respect your privacy and will not share any contact information, except as it pertains to this study and the project team. All information will be kept confidential and no locations or identifying information will be included in any published documentation.

YOUR CONTACT INFORMATION:

Name			
Mailing Address			
City			
Province		Postal Code	
Phone #		email	
Cottage Address/Location			

GENERAL INFORMATION ABOUT YOUR SEASONAL DWELLING						
Is your seasonal dwelling best described as an:		uninsulated summer cottage (under 1000 s.f.)				
		insulated (weatherized) cottage (under 1000 s.f.)				
		uninsulated summer house				
		insulated (weatherized) house				
What year was dwelling built or moved to it's present location (approx.)?						
What best describes the main foundation type?		Pole foundation	What best describes the main foundation building material?		Stone
		Open crawlspace			Concrete block
		Closed crawlspace			Poured Concrete
		Slab-on-grade			Wood
		shallow basement			Pressure Treated Wood
		full basement			Insulated Concrete
Is the foundation insulated?					Y/N	
WHEN DO YOU USE THIS BUILDING?						
What seasons do you typically use this dwelling?	Spring (Feb/Apr/May)	Summer (June/July/Aug)	Fall (Sep/Oct/Nov)	Winter (Nov/Dec/Jan)		
How many weeks out of each season						
Is there a typical 'opening' date?	☐ Yes ☐ No	Is there a typical 'closing' date?	☐ Yes	☐ No		

INFORMATION ABOUT MOLD AND MOISTURE PROBLEMS IN THE DWELLING
Do you have to air out this dwelling when you first open it for the season of use? ☐ Yes ☐ No If yes, please explain
Have you observed mold in the house when you first open it for the season? ☐ Yes ☐ No If yes, please indicate where
Have you observed mold growth in the house during the season of use? ☐ Yes ☐ No If yes, please indicate where
Have you ever cleaned mold out of the house? ☐ Yes ☐ No If yes, please explain
How often do you clean mold out of the house? ☐ Never ☐ Seldom ☐ Frequently
Have you ever had standing water in the dwelling? ☐ Yes ☐ No If so, please explain
Have you ever seen evidence of water leakage into the dwelling? ☐ Yes ☐ No If so, please explain
Have you had problems with condensation on the windows? ☐ Yes ☐ No If so, please explain

INFORMATION ABOUT THE SITE AND THE AREA SURROUNDING THE DWELLING		
Where is this dwelling located?	☐	Close to a lake
	☐	Close to the ocean
	☐	Close to a river
	☐	Close to a seasonal stream
	☐	Close to a year-round stream
	☐	In a forest clearing
	☐	In a field

What is the approximate distance from the nearest side of the house to the water? _____feet

Is the water source uphill or downhill from this dwelling ☐ Yes ☐ No

WINDOWS

Do you have south or west facing glass?	☐ Yes ☐ No
Which direction do most of the windows face?	☐ N ☐ NE ☐ E ☐ SE ☐ S ☐ SW ☐ W ☐ NW
What percent of the windows face this direction?	☐ <20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ >80
Do you have shutters on any windows? (if yes, please indicate the direction they face)	☐ Yes ☐ No ☐ N ☐ NE ☐ E ☐ SE ☐ S ☐ SW ☐ W ☐ NW
Do you have awnings on any windows? (if yes, please indicate the direction they face)	☐ Yes ☐ No ☐ N ☐ NE ☐ E ☐ SE ☐ S ☐ SW ☐ W ☐ NW

INFORMATION ABOUT POWER SUPPLY TO THE HOUSE (to determine the method of monitoring, if required)

Is there utility-supplied power to this dwelling?	☐ Yes	☐ No
Is there a stand-alone power system?	☐ Yes	☐ No
Do you run the power year round?	☐ Yes	☐ No
Could you run power year round?	☐ Yes	☐ No
Is there a land-based phone line?	☐ Yes	☐ No

INFORMATION ABOUT THE HEATING SYSTEM					
What best describes the primary heating system		N/A	What best describes the secondary heating system		N/A
		Electric baseboard			Electric baseboard
		Electric furnace			Electric furnace
		Oil furnace			Oil furnace
		Oil Boiler			Oil Boiler
		Gas/Propane furnace			Gas/Propane furnace
		Gas/Propane boiler			Gas/Propane boiler
		EPA-approved Woodstove			EPA-approved Woodstove
		Non-EPA approved woodstove			Non-EPA approved woodstove
		Open fire place			Open fire place
		Fireplace Insert			Fireplace Insert
		Pellet Stove			Pellet Stove
		Oil Stove			Oil Stove
		Other			Other

What best describes the type of mechanical ventilation system		N/A
		Exhaust fans in bathroom(s)/kitchen
		Central Exhaust
		Air exchanger w/out heat recovery
		Heat Recovery Ventilator

Thank you for completing this survey! The first 100 survey respondents will recieve a copy of CMHC's 'Clean Air Guide', and all respondents will be notified of the final report, due to be published in late 2005. Twelve homeowners who are planning renovations and who's buildings have existing moisture problems will be invited to take part in the field study, which includes an EnerGuide for Houses evaluation and an Indoor Air Quality Investigation carried out by a CMHC-trained technologist (a value of over $1000) and expert advise from our project team on mitigating existing moisture problems.

Would you like to recieve updates of the project? ☐ Yes ☐ No

If yes, shall we send them via ☐ email (please include this on page one!)

☐ regular mail (is your mailing address complete?)

9 Promotions

9.1 List of promotional activities

Date	Activity	Number Distributed	Resulting Calls or Inquiries
Fall 02, Ongoing	Posters throughout Mainland Nova Scotia (Venues include hardware stores, marine supply outlets, bakeries, diners and cafes in heavily populated 'cottage country')	150	at least 5
Nov 02	Kentville Publishing, Annapolis Valley coverage (ad and editorial content)	30,000	none
June 03	Handbills, throughout Mainland NS and Cape Breton	200	at least 5
July 03	FOCA website announcement and link	?	1 to 4
July 03	IAQRC website announcement and link	?	?
July 03	Nova Scotia Outdoors website announcement and link	?	?
May 03	CN Wire announcement w/link to press release on website		2
May 03	Mail Out: NS Homeowners/Lot Owners/Property Owners Associations	42	0
May 03	Mail Out: NS B&B Owners	25	0
May 03	Mail Out: NS Cottage/Lodge Rental Operations	32	1
May 03	Mail Out: NS Property Management Companies	15	0

July 03	Nova Scotia daily and weekly papers, local radio programs and cable media outlets	34	1
July 03	Mail Out: NS Gov't Employees email list	to be confirmed	12
July 03	CBC Radio One: Maritime Noon, 10 minute	n/a	10
Aug 03	Mail Out: NS Council of Archives	50	3
Traceable Responses			35 -40

9.2 Press Releases

NOVEMBER 2002

Mold, Moisture and Musty Cottages

CMHC has enlisted Nova Scotian firm, Abri Sustainable Design & Consulting to investigate moisture problems in seasonally occupied homes. The goal of the project is to determine what causes moisture in houses when there are no occupants, and test some low to medium cost solutions. The results will benefit owners of cottages, summer homes and buildings that are vacant for other reasons (e.g houses where residents take extended vacations, houses for sale or rent, or are otherwise deserted for long periods of time). “Almost any Canadian who has stayed in a cottage can wax poetic about cottage life,” says project coordinator Shawna Henderson. “Many of those descriptions will include an accurate evaluation of the familiar musty smell welcoming you when you open the summer house or cottage for the season – the same can hold true for the house that was closed up while you were on vacation.”

Canadian research has mainly focussed on moisture problems in full-time houses where high humidity can cause moisture problems during the winter, when doors and windows are kept closed. Humidity levels increase through occupant activities such as cooking, washing and bathing. Research on reducing these winter moisture loads has led to such measures as mechanical ventilation requirements in the National Building Code for new year-round dwellings.

Homes left unoccupied for extended period s of time have moisture problems too, but, when they are closed up, they don’t have the occupant-generated moisture sources found in year-round homes. What causes moisture problems when people are not living in these buildings? Some possible sources that will be explored include the location and general site conditions and the structure itself. The orientation of windows to the sun will be looked at as well – south and west facing windows can act as ‘solar cookers’, especially in the winter. If there is not enough mass to absorb the sun’s heat and no heating system in operation, wild temperature fluctuations could lead to condensation and good conditions for mold growth.

“When moisture sources are open crawlspaces or dirt floor under foundations, the solutions are straightforward building envelope fixes,” explains Terry Watters, of SHE Consultants, who is leading the field study. “There are known solutions for these problems, but where we find less obvious moisture sources, or

where moisture problems continue to occur," he continues, "options such as selective shading, antimicrobial coatings, intermittent ventilation and other solutions will be investigated."

The study includes a national web-based questionnaire and field-testing of solutions that will take place in the Maritimes. High summer humidity, long, reasonably warm and wet autumns and a cold winter with several freeze-thaw cycles leading to a typical wet spring leave the region with year-round airborne moisture problems as well as seasonal flooding and runoff issues. As well, a wide range of seasonally occupied houses is common throughout the Maritimes. "It's due to the diversity of seasonal home types and our wet climate," explains Ms. Henderson, "that we are able to look at the Maritimes as a worst-case scenario for the rest of Canada."

Twelve houses will be chosen for the field study, and those homeowners will receive an EnerGuide for Houses evaluation and a CMHC-certified Indoor Air Quality Investigation, a value of over $1,000.00. Homeowners who are interested in participating in the national study can visit http://www.abridesign.com/survey.html or leave their contact information at 1.902.489.1014.

– 30 –

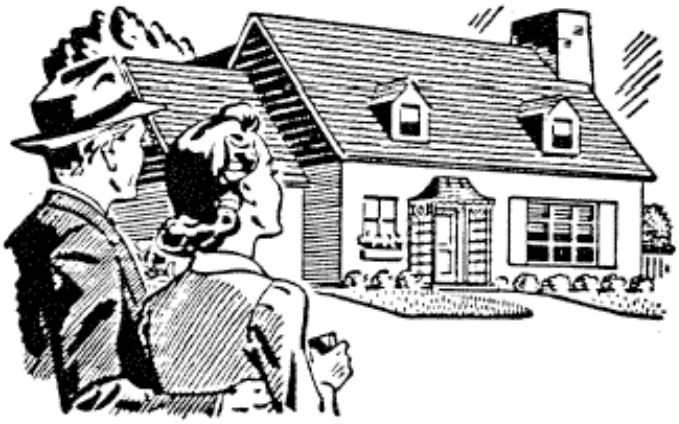
MAY 12, 2003

Opening the Cottage

A new national study sponsored by Canada Mortgage & Housing Corporation (CMHC) investigates moisture problems in homes left unoccupied for extended periods of time, such as cottages, vacation and second homes. The study begins with a national web-based survey of homeowners during the Summer 2003. Once the survey results are in, field-testing cost-effective solutions becomes the primary focus of this two-year project. Homeowners who are interested in participating can go to http://www.abridesign.com/survey.html or leave their contact information at 1.902.489.1014 or email: info@abridesign.com. The research is carried out by Abri Sustainable Design & Consulting of Halifax, NS.

– 30 –

9.3 Poster/Handbill



Moisture or Mold Problems?

A new national study sponsored by Canada Mortgage & Housing Corporation (CMHC) investigates moisture problems in homes left unoccupied for extended periods of time, such as cottages, summer or second homes.

You're invited to take part in a 10 minute online survey to help solve this problem at **www.abridesign.com/survey.html**

Field testing cost-effective solutions is a primary focus of this research. In Nova Scotia, twelve homes will be selected for testing over a two year period. Each will receive an EnerGuide for Houses evaluation and an Indoor Air Quality investigation, carried out by a CMHC-trained technologist (a combined value of over $1,000.00).

Research conducted by:

Abri Sustainable Design & Consulting

www.abridesign.com

Phone 1.902.489.1014

9.4 Text of Letter to Homeowners' Associations, Rental Agencies, etc.

Abri Sustainable Design & Consulting is carrying out a study sponsored by CMHC to investigate moisture problems in seasonally occupied homes.The goals of this study are to look at the causes of moisture in these houses and to test some affordable solutions. The project includes a national survey and field-testing solutions in Nova Scotia.

Who will benefit from the results?

- Cottage Owners
- Vacation/Summer Home Owners
- Owners of houses for sale or rent
- Seasonal house and cottage rental businesses

Canadian research has focussed on moisture problems in year-round houses. That's because in winter, when doors and windows are kept closed, humidity levels rise with moisture-producing activities such as cooking, washing and bathing. The results can be structural damage as well as indoor air quality problems. Homes left unoccupied for extended periods also have moisture problems without the occupant-generated moisture loads of year-round homes — why? Possible sources include the site, the structure and the orientation of windows. We will be looking at low-cost solutions like selective shading and intermittent or passive ventilation as well as general building 'envelope' remedies.

What's in it for you?

A copy of CMHC's 'Clean Air Guide' will be given to the first 100 survey respondents, and all survey respondents will be notified of the results of the study. The field study houses will be chosen from Nova Scotia buildings with existing moisture problems whose owners are planning upgrades or repairs. The owners of the field study houses will receive an EnerGuide for Houses evaluation and an Indoor Air Quality Investigation carried out by a CMHC-trained technologist, a value of over $1,000.00. Building owners also get the benefit of our expert project team's advice on the best solution for existing moisture problems. Each field study house will go through the following process:

Fall 2003: Evaluation and Investigation carried out & report generated
Winter 2003: House monitored for temperature and humidity fluctuations
Spring/Summer 2004: Project team, in consultation with homeowner propose low-cost solution for house
Summer 2004: Homeowner carries out work as proposed by research team
Winter 2004: House monitored for temperature and humidity fluctuations
Spring 2005: Analysis of success of the low-cost solutions, further consultation with project team
Spring/Summer 2005: Report and 'how-to' pages written by research team for publication by CMHC

Thanks in advance,

Shawna Henderson
Abri Sustainable Design & Consulting
phone: 489-1014
fax: 821.2112
email: shawna@abridesign.com
URL for survey: abridesign.com/survey.html

9.5 Text of email announcement sent to rental agencies, engineers/designers and IAQ providers

Hello!

It's that time of year again. Time for the annual ritual of airing out the summer house, second home or vacation place. Most of us are familiar with that musty smell, the result of a winter's worth of stale, damp air. Is this a fact of life or is there an inexpensive fix? Canada Mortgage and Housing Corporation (CMHC) has sponsored a national study that investigates moisture problems in homes left unoccupied for extended periods of time.

Unsolved moisture problems cause damage to both structural and occupant health. The resulting costs can be high. The focus of this project is to test affordable solutions. The first phase, a cross-Canada online survey, determines which types of houses are experiencing what kind of moisture problems. The participation of homeowners from all regions of Canada will help us choose the most appropriate houses for field testing solutions. At the end of the project, 'how-to' pages will be available free of charge in pdf format and print as well.

We are asking businesses, organizations and associations like yours that support cottagers and other vacation-home owners to promote the online survey through a link to our website and an email announcement to your membership. This study is led by Abri Sustainable Design & Consulting of Halifax. For more information on the project, please visit www.abridesign.com/survey.html, call 1.902.489.1014 or reply to this email address.

10 Recommendations to Homeowners

The following introduction was included with all homeowner letters. It has been extracted from the copies of the letters that are included here.

“Thank you for your participation in the Moisture in Seasonal Housing Study being carried out for CMHC by Abri Sustainable Design. We include in this package the results of the EnerGuide for Houses evaluation and the Indoor Air Quality Survey that were carried out in the fall of 2003 in your cottage, as well as the CMHC guidelines for cleaning mold. Attached to the end of this letter is a standard disclaimer usually attached to the Indoor Air Quality Investigation Report. We have collected the sensors from your house and are analyzing the data from them now. This will give us a better picture of what is happening in your house on a seasonal basis, and will help us determine the best approach to helping you reduce or eliminate the mold problems in your house.

Recommendations

As discussed during our phone conversation and during the initial site visit, the format adopted for Indoor Air Quality (IAQ) reports uses prioritized remediation suggestions according to their significance. The reasons for initiating the IAQ investigation was as part of the Moisture in Seasonal Housing Study being carried out for CMHC by Abri Sustainable Design. Please refer to the summary. The recommendations are divided into three groups. The first group of recommendations can for the most part be undertaken easily and at very little cost. The second group of recommendations is of medium cost and finally some measures are of higher costs. Some of the lower cost measures may overlap with the medium cost measures and medium cost measures with some of the higher cost recommendations. These are offered as options so that you can make informed choices based on your needs and budget.”

Following are the bodies of letters sent to each of the homeowners participating in the field study, by house file number.

10.1 UNINSULATED COTTAGE: MSTNSA81

May 10, 2004

No Cost/Low Cost Recommendations

Prior to cleaning up the mold on walls and permanent fixtures, repairing water leaks and other sources of moisture, it is important to reduce potential mold growth on soft and/or permeable surfaces in the main part of the house. There should be a general clean up of living area to remove old boxes, mattresses and carpets and bedding. We suggest not storing bedding in the house, or storing it in airtight containers. Remove and dispose of any of the following items that have visible mold growth or mold stains on them, or have a heavy musty odour to them:

paper products (including cardboard boxes and books)

throw rugs and the carpet on the stairs (and any underlay)

bedding

mattresses

upholstered furniture

any decorative pieces of wood

Unless these items can be thoroughly cleaned with a bleach solution to kill the mold spores, they will only continue to add to the problem and should not be re-introduced into the house.All interior surfaces and fixtures that have evidence of past or present mold growth should be removed from the house (where possible), cleaned thoroughly with a bleach solution and reinstalled. This should be done during a hot and dry spell to ensure the house dries out as much as possible.
Holes in the building envelope (gaps in the board and batten siding) should be repaired to reduce moisture infiltration and animal access.

Condensation on single pane windows can be dealt with during the winter season by installing ‘shrink wrap’ interior plastic ‘storm’ windows. This is a plastic sheet that is attached to the window frame by a double sided tape, then a hair dryer is used to shrink the plastic to fit the window. Eliminating condensation on the windows through the winter season will help reduce or eliminate mold growth on the windows.

Remove or cover up exposed fiberglass batt insulation. This is a health hazard, as the fine particles and strands get into the air and can be breathed in by occupants.

Drop the grade around the house so that there is at least 24 inches between the bottom of the floor joists and the finished grade. With the floor joists as they are (in some cases 9 inches above the ground), there is significant chance of structural damage due to moisture problems. There is already sign of moisture damage on the lower parts of the siding. Dropping the grade as much as possible will allow air to flow freely around and under the house, reducing the amount of moist air that could be trapped in the now partially blocked crawlspace. The finished grade around the house should have positive drainage away from the crawlspace (a slope of at least 2% away from the house). Where it was accessible, the underside of the joists showed some mold growth. To further encourage air flow, shrubs should be cut back around the foundation.

Medium Cost Recommendations

All chipboard/aspenite or other manufactured sheet wood product should be sealed with several coats of a water-based varathane or other sealant to reduce offgassing and to extend the life of the product. These sheet wood products are very susceptible to moisture damage and can lead to significant structural woes as their condition deteriorates.

High Cost Recommendations

Leaks in corrugated fiberglass or acrylic panels are very difficult to repair. In fact, creating an area in the roof with glazing is very tricky to accomplish with no leakage. As well, at some point, the panels will break down and need to be replaced. Consider a different roof glazing that is more easily sealed and more permanent in nature. Careful attention needs to be paid to the flashing details of any roof glazing or skylite system.

Add a fan (high speed, quiet – 100 cfm, less than 2 sones) to take the moisture out of the bathroom. This could be tied to a humidistat so that humidity can be controlled during the winter when the building is unoccupied. The humidistat is set to run the fan when the relative humidity inside the house rises above 55 to 60%.

Summary

For the amount of water leakage evident, there was not as much mold growth as anticipated. However, the volume of soft surfaced items (books, cardboard boxes and other stored items) that can absorb a large amount of moisture may be masking a larger mold problem. These items should be removed from the house, the house cleaned of any evident mold on the permanent surfaces and fixtures, and the roof leaks and gaps in the siding permanently repaired. Soft surfaced items (bedding, books, etc.) can be reintroduced prior to roof and siding repair, but they should be stored in airtight containers.

The perimeter of the house at the foundation should be dropped to allow more air movement under the house. The final grade around the perimeter should slope away from the house on all sides to ensure that surface water does not collect under the house.

A bathroom fan tied to a humidistat control could reduce or eliminate condensation problems inside the house when it was unoccupied.

We look forward to working with you further to find a viable solution to the moisture problems in this house.

10.2 WEATHERIZED COTTAGE: MSTNSB78A & MSTNSB78B

June 30, 2004

As per our conversation and site visit on June 21st, we have revised our recommendations.

General Recommendations for Moisture/Condensation Control

The windows were showing evidence of mold growth. The least expensive way to avoid this is to put up 'shrink wrap' plastic film on the interior of the windows for the closed season, according to manufacturer's instructions. This product is available at any hardware store and is easily installed.

Jacuzzi tubs are often the cause of mold and humidity build-up in bathrooms. We didn't see much evidence here, which is probably due to your high standard of cleaning. The only recommendation here is that you install 'curbs' where the tubs meet the enclosure walls to ensure that there is no overflow/splash and further water damage to the wall below the tubs (we noted that repairs had been made to the drywall).

Keep on with your regime of leaving the bathroom fans toggled 'on' when guests arrive. The more you can encourage guests to use the fans during showers, baths and other moisture-producing activities, the less you will have to deal with moisture problems.

Keep the vents to the crawlspaces closed.

The attic hatch in all cabins could be improved for energy efficiency as well as helping to reduce moisture issues (see 'Keeping the Heat In', published by Natural Resources Canada).

CABIN #1:

The underside of the trapdoor to the crawlspace has mold growth and staining on it. After cleaning the mold off and allowing the trapdoor to dry, two coats of a good oil-based paint on this plywood surface should remedy the problem.

Medium Cost Recommendations

Currently, your bathroom fans are 'hardwired' to the light switch, with a toggle chain that allows guests to turn off the fan if it is too noisy for them. Upgrading to a stronger, quieter fan (less than two 'sones', as you already have) will reduce the moisture load in the bathroom more quickly. Having the fan on a timer could be a more viable solution than the toggle, as guests may turn off the toggle and then forget about the fan for their stay. A timer with a note to please turn on for a specified amount of time might be more of a memory jog.

High Cost Recommendations

For energy efficiency, and for reduced moisture infiltration/possible mold growth into the crawlspace, a layer of rigid board insulation should be placed on the interior of the crawlspace walls over their the full height. A bead of acoustical sealant should be laid on the overlap of the poly moisture barrier that runs under the gravel on the floor. Another bead of acoustical sealant should be laid along the top edge of the concrete wall. The rigid board insulation should then be pressed up against the wall. If you do this, the vents must be permanently closed off. The floor joist header area should also be insulated with a layer of rigid insulation.

If the crawlspace is left uninsulated, then the vents should be closed except during the early spring and late fall when the exterior relative humidity levels and the temperatures are both low. Opening these vents during the higher humidity seasons and the winter will increase the moisture loading and could possibly lead to mold growth.

General Indoor Air Quality notes for both (possibly all?) cabins:

There was a high concentration of pressed wood and manufactured wood furnishings, presumably offgassing considerable amounts of formaldehyde. To improve the air quality in these cabins, seal the exposed unfinished surfaces of all furniture that is not solid wood (ie, pressboard, medium density fibreboard and other engineered wood products). The sealant used should be a water-based varathane, or latex primer.

Clean the bathroomfan grilles on a regular basis.

Carpets (and chemical carpet cleaners) were a primary odour when the cabins were visited after being closed up. When the carpets need to be replaced, they should be replaced with pre-finished hardwood, laminate flooring or ceramic tiling, all of which have a longer life than carpets, are more easily maintained than carpets, withstand more abuse than carpets, and improve the overall indoor air quality.

We will contact you at the end of the season to arrange a convenient time to re-install the sensors for the second year of the study. Thanks again for participating, and please don’t hesitate to call if you have any questions regarding moisture or mold issues.

10.3 WEATHERIZED COTTAGE: MSTNSB90

June 7, 2004

No Cost/Low Cost Recommendations

There was no access into the flat roof to see what was going on above the ceiling, but when the blower door was running, a musty smell was found at the plumbing and other penetrations through the ceiling. You might want to take one or two ceiling tiles down and check out the condition of the insulation and the structure of the flat roof. There were 15 air changes in this house, so there is a lot of air sealing that could take place, especially at the ceiling penetrations and the wall/ceiling and wall/floor joints.

A significant amount of air leakage was noted at the slab/wall connection. The grade is very close to the top of the slab, and leaves and other debris were piled up at the perimeter at the site visit, especially along the original portion of the house. There is most likely no sill gasket here, and there could be moisture and mold transfer through the bottom sill plate. As you have already done some grading work, the lowest cost solution would be to seal the area between the floor and wall behind the baseboards and the area where the wall meets the ceiling. This would help keep any potential mold growth outside the living space. A further recommendation would be to drop the grade all around the house so that there was at least 6” of the foundation exposed. In some cases, the grade is now touching the exterior wall surface, allowing moisture to be transferred to the wall. These areas need to be lowered. Keep leaves and other debris away from the perimeter of the building.

To reduce the amount of condensation on the windows, when closing up the cottage, install temporary interior storms (‘shrinkwrap’ for windows). This will stop air leakage and make the ‘first condensing’ surface outside the building envelope.

General clean up to remove old upholstered furniture, mattresses and bedding. Suggest not storing bedding in the house, or storing it in airtight containers. All soft surfaced items that show evidence of mold growth or stains should be removed and disposed of to avoid further mold growth.

The initial recognizable odour was musty, but the new pine panelling on the new addition was quite strong, so it is difficult to tell what the underlying odours really are.

Where there is evidence of water staining on the windows, this should be cleaned up immediately up on opening the house to eliminate any possible mold growth. Sealing the windows as noted above will take care

of the condensation issues during the winter, but when the cottage is in use, the window sills and frames should be inspected periodically for mold growth.

As per your conversation with Pat Murphy in May of this year, the perimeter of the new addition should be sealed to keep the rodents out. Replace exterior siding that is missing, finish outside of addition.

Medium Cost Recommendations

Condensation was noted on windows during the site visit. Install a bath fan with a humidistat control to reduce the moisture levels in the house during the closed season.

High Cost Recommendations

There was some evidence of water damage on the flat roof of the original building. Ensure the drainage for this flat roof is adequate and clear of debris, and that it drains away from the house. The back corner of the original building, where the electrical meter is located, is where the water damage is on the trim and a large wet mark was seen on the bottom half of the wall during the site visit. Also, during the site visit, which was just after a rain the evaluator found a very wet, muddy patch of ground here (lost his shoe in it!). This is probably where the excess rainwater is draining off the roof. Moisture problems could already be an issue on this corner of the house, leading to structural damage as well as indoor air quality issues. This should be addressed as soon as possible, the wall and trim repaired and the drainage improved.

The new portion has a gable roof and should have eavestroughing with downspouts and rainwater leaders installed to keep the moisture away from the perimeter of the crawlspace.

The at-grade deck is right up to the perimeter of the house, which, as noted above, is a concern. There should be a space between the deck and the side of the house to allow for air movement and moisture reduction. When the deck is replaced, you might want to consider a stone or concrete terrace that is at least 6” below the top of the concrete foundation.

On the original portion of the house, the slab extends past the exterior siding, exposing the slab to rain and snow. Where the slab is exposed, there should be a piece of continuous flashing installed to direct the rain off the slab and out of the walls.

A continuous flashing with a drip-edge should be installed under the exterior siding on the addition, with the siding ending above grade (ie, do not extend the siding to cover the crawlspace area). The grade around this addition could be lowered as well to improve air circulation under the crawlspace and to allow access to inspect the crawlspace in the future.

Ensure all final grades are sloped away from the slab and especially the crawlspace to ensure the moisture is not puddling under the addition.

Summary

The solutions recommended for this house include air sealing at the wall/ceiling junction to reduce moist air infiltrating the flat roof of the original cottage, and lowering the grade around the outside of the foundation so there is less chance of moisture/water penetration at the base of the wall. A bathroom fan with a humidistat control could help reduce condensation on windows during the closed season. Further reduction of window condensation would be to install temporary interior storms for the closed season (the ‘shrinkwrap’ plastic material).

The drainage from the flat roof needs to be inspected and kept in good repair, and eavestroughing should be installed on the new gable roof of the addition, with downspouts and rainwater leaders to move the water away from the open crawlspace foundation.

We look forward to working with you further to find a good solution to the moisture problems in this house.

10.4 WEATHERIZED COTTAGE: MSTNS95

May 13, 2004

Because of the overwhelming presence of mold in your cottage, we will keep the focus of this report on what to do about the mold. The mold problem seems to be arising from a combination of humidity and temperature fluctuations. Long-term solutions should be focussed on preventing these fluctuations. As part of the study, the project team will be working with you to determine the best approach to a long-term solution so that you can use your cottage again.

No Cost/Low Cost Recommendations

As items stored in the basement were reported as being damp upon removal, do not use the basement as a storage area. Firewood is a good medium for mold growth in the house, so it should be stored outside under cover.

After everything has been removed from the basement, the exposed wood joists and cross-bracing should be cleaned with as per CMHC guidelines (a copy is attached) and the concrete should be washed down with TSP (trisodium phosphate). The wood furnace should be fired up to help dry the surfaces out and reduce the chances of immediate mold growth. At this point, the 4 open vents in the basement should be closed off. They should only be opened during the early spring and late fall, when the level of relative humidity in the outside air has dropped.

To reduce potential mold growth on soft and/or permeable surfaces in the main part of the house, remove and dispose of any of the following items that have visible mold growth or mold stains on them, or have a heavy musty odour to them:

paper products (including cardboard boxes and books)

throw rugs and the carpet on the stairs (and any underlay)

bedding

mattresses

upholstered furniture

any decorative pieces of wood (including toilet seat)

These items will have, by now, been saturated with mold and, unless they can be thoroughly cleaned to kill the mold spores, will only continue to add to the problem.

Close off the vents in the basement with pieces of rigid foam insulation that are cut to fit the openings. The vents should be blocked off throughout the year, except during the early spring and late fall when the exterior relative humidity levels and the temperatures are both low. Opening these vents during the higher humidity seasons and the winter will increase the moisture loading, leading to mold growth. Also, ensure the finished grade is lower than the sill of the vents, and that it slopes away from the house. If the basement is insulated (as noted in the higher cost recommendations), then the vents should be blocked off permanently.

The mold clean-up and the vent blocking should take place at the same time, to reduce the potential for more mold growth on remaining surfaces.

Medium Cost Recommendations

Pull gypsum board off all wall and ceiling surfaces, as this has become completely contaminated with mold. When the gypsum board is taken off the walls, pull out the rigid board insulation and check its condition (and the condition of the wall cavities). This is the point where the project team can really evaluate what approach to take with the house in regards to renewed insulation options, air barriers, passive ventilation and other factors that need to be addressed to reduce the potential for mold growth. If there is evidence of mold contamination, a proper clean-up will be required. For instance, the exposed wall cavities should be thoroughly cleaned over the summer period and then left open for the next winter to see what effect this has on the mold growth situation. If, at the end of the study period, the mold growth is reduced significantly, a better finished wall and ceiling solution would be a sealed wood product, like the varnished pine boards in the upper floor.

High Cost Recommendations

In a cottage that has a year-round electricity supply, an obvious solution to control the fluctuations in temperature and humidity would be to install an inexpensive year-round heating system with ventilation capacity. In your situation, a possible solution could be two gravity-feed oil-fired radiant space heaters, one on the main floor and one in the basement. These heaters require no electricity. As you wouldn’t need to keep the thermostat very high in the winter (it could be left at 55°F), the amount of oil required to keep the house at a constant temperature would be much less than in a regular house that is kept 20° higher all winter. This would require an insulation upgrade in the basement to ensure you were not losing all the heat to the outdoors. In addition, the basement vents would have to be blocked off permanently.

Summary

Until the source of the mold problem has been identified and a solution has been found that reduces or eliminates it, leave the cottage as bare of soft surfaces as possible. Leave the floors bare of rugs and carpets, and store remaining paper products in airtight containers. Consider storing bedding and towels, etc. at home instead in the cottage. Mattresses and upholstered furniture should be left out of the house for now. If you keep the cottage fully furnished at this point, you will end up having to remove and dispose of further bedding, books and magazines, carpets and furniture.

As part of the solution to mold growth and as part of tracking down the mold source, we recommend that the house be cleaned as thoroughly as possible and that the basement vents be blocked off. Further, the gypsum board on the walls and ceilings should be torn down, as it is completely saturated with mold. The wall cavities and insulation should be investigated and thoroughly cleaned. Once the condition of the walls has been determined, the project team will offer up the best practice interior wall assembly.

A passive ventilation strategy at the peak of the building may work well in this house once the building has been cleaned of mold and the basement vents are sealed.

The best way to even out the temperature and humidity fluctuations in the long run is to install a heating system and perhaps some passive ventilation capacity. The suggested option for this house is to install two gravity-feed oil-fired radiant heaters, one in the basement and one on the main floor. An insulation upgrade for the basement will be required for this option.

This sounds daunting, but we will help you as much as we can in our capacity of consultants so that you can once again enjoy your cottage. We will be in touch shortly to arrange for an on-site visit to further investigate the house and discuss the options with the rest of the project team members.

June 30, 2004

As per our meeting on June 21st, we have revised our recommendations to better suit your requirements, and what was observed during that on-site visit.

The basement was much improved over the winter/early spring visits in terms of active mold growth and dampness. The main living space mold seems to have mainly dried out as well, although the surfaces are still heavily covered by mold.

As noted, it looks as though there is a pattern of air, heat and moisture movement in the main living space. This pattern seems to be causing the moisture to condense out of the air onto most surfaces in the main living area below the loft railing level. In contrast, the upper floor loft (open to the main living area) and the small bedroom upstairs were surprisingly clean of mold. As these are tucked back from the open space of the front of the house, they could be 'disconnected' from the air movement pattern and therefore not affected by the fluctuations in temperature and moisture level.

The kitchen and bathroom, both on the North face of the building, and with sources of moisture (ie, trapdoor to basement is in kitchen, toilet bowl in bathroom), were the areas with surfaces most heavily covered with mold.

The actual house site is quite damp, as shown by the large amount of mold growth on the exterior surfaces of the house, in the sunporch and on the woodshed. There was no mold on the wood surfaces leading to the little dock, which, although within a few paces of the house, is in direct sunlight.

Recommendations

The following recommendations address the most likely moisture-causing issues. Carrying these recommendations out will combine to reduce the amount of moisture in the house, which will reduce – or possibly eliminate – new mold growth. However, they will not fully address the possibility of continued mold growth in the existing drywall, as there is no way to know the extent of the damage there without stripping out the walls. If, after these recommendations are carried out, there is still significant mold growth on the walls, the drywall will have to be stripped out and replaced.

Area Surrounding House:

The forested area in the north and west quadrant of the house should be thinned and limbed up to 10 feet or so. This will allow more air movement around the building. Currently, any breeze that is coming down the river is blocked and the house is sitting in a pocket of very still, moisture laden air.

Limbing a few trees to the south and southwest – or even cutting out one or two of the larger coniferous trees – will give more direct solar gain to the house and will allow for even more air movement around the building (without making it a wind tunnel!). This will help to improve the microclimate around the house.

Basement:

Clear out all firewood and other stored items from the basement.

Wash down the interior foundation concrete with TSP (trisodium phosphate). The wood furnace should be fired up to help dry the surfaces out as they are cleaned.

Close off the four vents in the basement with the solid shutters that are already in place. Use ‘peelable’ caulking to ensure the vents are completely closed off, yet can be re-opened.

Re-grade around the basement vents so that there is 6 to 9 inches of space between the bottom of the vent and the finished grade to eliminate potential water/snow melt leakage at this area.

Main Living Area, Kitchen, Bathroom and Lower Bedroom:

Remove and dispose of any of the following items that have visible mold growth or mold stains on them, or have a heavy musty odour to them:

paper products (including cardboard boxes and books)

throw rugs

bedding

mattress in lower bedroom

upholstered furniture

any decorative pieces of wood (including toilet seat)

The taxidermy pieces should be inspected for mold growth and removed from the building during the clean up phase.

The new mattress upstairs should be taken out of the building during the clean up process and the coming winter. If it is impossible to take the mattress out of the house, it should be wrapped completely in polyethylene sheeting with all seams carefully taped to keep the mattress out of the moist environment.

Anything that is to be brought back into the house should be cleaned as well as possible outside the house and thoroughly dried before being brought back into the completely cleaned and dried house.

There is a great little companion booklet from CMHC on cleaning wood, upholstered surfaces, leather and so on after a flood. We will get an updated copy to you as soon as possible.

Clean mold (active and inactive) off all drywall surfaces and trim as well as cabinetry and furniture and solid floor/ceiling finishes. Use CMHC's guidelines for clean up: only dishsoap and warm water, keep the windows wide open and those who are doing the work must wear appropriate protective masks, as outlined in the CMHC guidelines.

Use up the firewood in the furnace once the cleaning process is under way to help dry out the house quickly. Keep the house open as much as possible and after the process to help dry out the main living areas. Windows should be closed before evening falls and on damp or rainy days.

Improve the air circulation by opening the closet doors. In addition, when you are staying in the house, hang the clothes loosely so that air can circulate around them. Dry all wet clothing (including clothes wet from rain or perspiration) before putting it in the closet.

After all surfaces have been scrubbed and are thoroughly dried, repaint walls and ceilings with an oil-based paint. Keep windows and doors open as much as possible to ventilate the house while the paint is being applied and while it is drying.

Cabinets, trim and all other exposed woodwork should be refinished as well.

Single pane windows should be sealed with plastic 'shrinkwrap' for the winter, the missing double pane for the kitchen slider should be re-installed and that window should also be sealed with plastic 'shrinkwrap'. As condensation was noted on other windows, this might be useful on all windows.

Once the house has been dried out, the floor vents from the furnace should be closed off. As you indicated that the furnace is to be replaced with a woodstove, this would essentially disconnect the basement from the remainder of the house, reducing any moisture problems from the basement.

Install weatherstripping on the trapdoor to the basement, and inspect it on a regular basis to ensure that it is remains in good repair.

Seal the ridge beam with a bead of silicone or other clear caulking at all junctions to reduce air flow out of the house at the ridge. This, along with the basement work will stop the apparent air movement 'loop' that is happening in the house.

We are investigating the use of ‘desiccants’, or drying agents to keep further control the humidity levels. However, we need to find a ‘free draining’ product that is non-toxic and will not kill your septic field. We will keep you updated on this option. It may be that it is less expensive and less complex than installing a passive ventilation system. We are also working on the requirements for the passive ventilation system that would run along the ridge of the house. That is still very much in the prototype stage.

After the work above has been carried out, we will re-install the temperature/humidity sensors in the house and with the results, we will be able to compare moisture and temperature swings with last year’s data. If the mold growth remains a problem after the next winter has passed, you will most likely need to strip the drywall, as it is too contaminated to keep clean, and has become the source of mold growth. If you get to this point, the project team will help you evaluate what approach to take with the house in regards to best practices for refitting the walls.

It’s great that you’ve been able to get the house cleaned and are starting in on the painting. As we spoke about today, keep the cleanout on the furnace chimney open until you seal off the floor vents. As you stated, this has helped dry out the basement in the past, and, until you change how the air flows in the house (ie, isolate the basement from the house), it should help to keep the basement drier. My concerns around using the chimney as an exhaust flue for the basement after the floor has been sealed off are: the exhaust will only work if there’s an air inlet in the basement, and reopening a basement vent or vents to accommodate this will defeat the purpose of closing them in the first place. You will still be drawing moist air from grade level into the house.

We will have more discussion about the desiccants and the passive vent system as well as the chimney in the basement. In the meantime, if you need clarification on anything we’ve spoken about, please don’t hesitate to call.

10.5 WEATHERIZED COTTAGE: MSTNSB98

June 7, 2004

No Cost/Low Cost Recommendations

Mold was observed on the grouting in the tiles in the showerstall and on the wall immediately outside of the stall as well as on the toilet tank. Mold has been cleaned from the interior surfaces of the north walls in the past. This is most likely caused by high humidity levels (indicated by condensation on north windows) and no heat during the winter season.

Condensation on windows. This should disappear when ventilation system is installed, but in the meantime, to reduce the amount of condensation on the windows, when closing up the cottage, install temporary interior storms (‘shrinkwrap’ for windows). This will stop air leakage and make the ‘first condensing’ surface outside the building envelope. Single hung windows can also be sealed using removable caulking along all edges of the opening unit, especially the juncture between the top and bottom glazing.

To minimize moisture and air transfer at attic hatch, insulate to the same level as the ceiling and weatherstrip and seal the attic hatch tightly with hook and eye fasteners.

Heavy formaldehyde and VOC odours were noted at kitchen cabinets and counters as well as new furniture were apparent. These items should be sealed with a water-based varathane or other sealant product to reduce the amount of off-gassing from the unfinished edges and surfaces.

There was some odours coming from the propane heating appliances. As your plan is to remove the heaters in the bedrooms and installing electric baseboard heating, this should be taken care of directly. During the investigation, the main odour that was identified was a paint or sealant smell, coming off the propane fireplace and/or ducting/piping. The investigator could also smell the propane even though the fireplace and the water heater are both direct-vent. This is an indoor air quality concern, as the house has a very low air leakage rate. Have a qualified gas technician thoroughly inspect the fireplace and the water heater venting systems.

Take all wood and other soft-surfaced, or porous articles out of the crawlspace.

Medium Cost Recommendations

Because of moisture problems apparent in the crawlspace, it may be better to remove the gas water heater and install an electric heater in a closet in the main floor. Bringing the water heater into the heated space may bring operating costs down as well if the cottage is to be rented out over the winter months.

Ensure that the polyethylene sheets on the crawlspace floor are continuously lapped and sealed around the perimeter. It is unclear if this is the case now, however, photographs from the site visit show some areas that look damaged or missing, specifically around the plumbing penetrations. The moisture problem apparent at the site visit could most likely be controlled if the moisture barrier is in good repair. It is clear that the area where the water is coming into the crawlspace (where plumbing penetrations go through floor) that the moisture barrier is not continuous. Condensation and rust are apparent on the top of the water heater.

Ensure than all exterior finish grades slope away from the house and that all eavestroughing has functioning downspouts and leaders that take the water away from the foundation.

High Cost Recommendations

Given your observations of the winter season of 2002 when the house was in use, we recommend the installation of a high-efficiency heat recovery ventilator (HRV). The low air leakage rate combined with high humidity levels as well as higher mold growth during this particular season indicate the need for good ventilation. When the building is not in use, the ventilation system should be kept running at low-speed throughout the winter season. High heating costs can be brought down somewhat by using only the propane fireplace augmented by electric baseboard heaters in the bedroom. The baseboard heaters should be fitted with high-efficiency thermostats.

Summary

Moisture issues in the foundation could be corrected if the moisture barrier is continously lapped and sealed at the perimeter of the foundation. All porous and soft-surfaced materials should be stored somewhere else other than the crawlspace to reduce potential mold growth.

Install a high-efficiency ventilation system that is controlled by a humidistat to reduce moisure issues in the house during the winter season. This is especially important f you were to live in this house full-time, or rent it out during the winter, as the air change rate was fairly low and interior moisture levels will be higher when the windows are kept shut and the building is occupied.

If you don’t install a ventilation system before the next winter season, installing temporary interior storms will help reduce the condensation on windows.

The indoor air quality can be improved by removing the propane space heaters and installing electric baseboards. This may also reduce fuel costs significantly.

We look forward to working with you to find a good solution to the moisture problems in this house.

10.6 WEATHERIZED COTTAGE: MSTNSB101

May 10, 2004

No Cost/Low Cost Recommendations

On first entering the house, the predominant odours were musty mold, musty furniture. There was a leak from the fridge that travelled under the tiles and was causing an odour to arise from the floor, indicating moisture/mold is trapped there. Turning the heat on and running a de-humidifier in this area will most likely dry it out eventually. If the problem persists (you will be able to smell it, but also lift a tile to investigate), then stripping the affected tiles, cleaning the subfloor and replacing the tiles after the floor has thoroughly dried is the recommendation. Alternately, and more costly, replace the vinyl tiles with laminate flooring or ceramic tiles. When the floor is replaced, and regardless of the material used (the suggestions are best for good indoor air quality), ensure that the subfloor has been properly cleaned to reduce any chance of further odours emanating from the floor when it is warmed by the sun or other heating source.

Clean up of metal surface of kitchen exhaust fan. There is some grease etc. from fan use that was enough of a sub-strate for mold to grow upon.

In the living room and dining room, there was a musty furniture smell. To reduce potential mold growth on soft and/or permeable surfaces in the main part of the house, remove and dispose of any of the following items that have visible mold growth or mold stains on them, or have a heavy musty odour to them:

paper products (including cardboard boxes and books)

throw rugs and the carpet on the stairs (and any underlay)

bedding

mattresses

upholstered furniture

any decorative pieces of wood (including toilet seat)

These items could be saturated with mold and, unless they can be thoroughly cleaned to kill the mold spores, will only continue to add to the problem.

Mold clean-up needs to be carried out in the following areas on main floor: kitchen floor under the tiles, range hood, toilet tank, plastic tile around the tub.

There is condensation between the single pane window and the exterior storm window, this could lead to mold growth. One solution is to use peel-off caulking and seal the interior windows competely in the winter off-season. This caulking is available in most hardware/building supply stores.

Refrain from using air fresheners and potpourris, as these only mask the odours that could alert you to further moisture problems. Instead, reduce the soft surfaces that are left exposed during the winter and keep all permanent surfaces and fixtures free of mold.

In the basement, a good job was done on cleaning up and drying out after the flood in 2003. However, with the high levels of gas, oil and other solvent-based products (paints etc.) stored in the basement, it was impossible to tell the full extent of mold growth. All petroleum and solvent-based materials should be stored outside the house in a locked shed or other secure location, as they certainly have a negative affect the indoor air quality of this house.

The water tank is sitting on a foam block that is covered in mold. The water pump is also sitting on blocks that are covered in mold. Use a bleach solution to kill the mold here. Where there is mold present on concrete floors and walls (as in under the linoleum that the laundry tub sits on), use trisodium phospate (TSP) to kill the mold. Remove all linoleum from the basement to allow the floor to dry out. Do not replace the linoleum as it will consistently act as a partial moisture barrier and mold will grow on the back of it, but do run a dehumidifier in the basement and consistently during the times when the house is occupied. The spring and summer months are most critical. Keep the basement windows closed in the summer to avoid bringing in high-level humidity. It is important to empty and clean the dehumidifier regularly, as it can also become a significant source of mold growth when the reservoir is left full and standing. There is still some evidence of moisture along the bottom of the concrete block wall. Mold is also visible on the cast iron waste pipe and the exposed wiring in the basement.

Medium Cost Recommendations

The musty odours in the house could be reduced further. The upholstered furniture and mattresses should be cleaned thoroughly. Those that can't be cleaned should be removed or replaced. The furnace should be run throughout the winter, set at a temperature of 55°F/13°C. This will keep the house at a median temperature, eliminating one of the major causes of musty odours in soft furnishings – namely, temperature fluctuations that result in moisture condensing out onto surfaces.

Alternately, a bathroom fan exhausted to the exterior and controlled by a humidistat could be installed. This fan would kick in when the humidity levels rise above a predetermined level (say over 50%) and would shut off again when humidity levels dropped below this level.

High Cost Recommendations

If flooding continues to be a problem, the foundation will have to have work done on the exterior. This would entail an excavation of the foundation, new exterior drain tile installed with positive drainage away from the foundation. Install rigid board insulation (of a type approved for sub-grade use) against the whole height of the exterior of the concrete block foundation, damproof with a material approved by the foam manufacturer, and backfill with free-draining gravel. The final grades should slope away from the house on all sides at no less than 2% grade. We do NOT recommend insulating your concrete block walls from the inside, especially when there is a known problem with flooding. Where your EnerGuide for Houses evaluation indicates that insulation was placed on the interior of the basement walls, this was done for energy efficiency modelling purposes. The insulating quality of the rigid foam is still valid on the outside. Insulating the basement walls will reduce the energy required to keep the house temperature around 55°F/13°C if the furnace is run through the winter.

Summary

Mold clean-up will reduce the musty smells present in the house. Lift linoleum in kitchen and in basement to allow floors to dry out. Run the furnace at a low temperature (55°F/13° C) through the winter months to keep house at a median temperature. A bathroom fan controlled by a humidistat can reduce the humidity levels in the winter months. We look forward to working with you to find a viable solution to the moisture problems in this house.

10.7 UNINSULATED HOUSE: MSTNSC96

May 10, 2004

No Cost/Low Cost Recommendations

There was a musty odour that was identified as coming from the crawlspace of the original crawlspace. Install moisture barrier on dirt floor to eliminate or reduce odours caused by damp earth and mold growth. If the crawlspace under the two storey addition is accessible, it should be inspected for dampness and odours as well. If there is a dirt floor under this area, the same procedure as the original crawlspace is required. As access to both of these crawlspaces is limited, it is unlikely that anyone could do an adequate job of cleaning and sealing the spaces from below. In that case, it may be that this clean-up has to be initiated from the floor above, putting it into the high-cost category. However, attending to the crawlspace from the floor above may be less expensive than digging out a new basement under the original portions of the house. Please read further under ‘high cost solutions’.

However, installing a low-speed fan in the crawlspace effectively puts the area under negative pressure, meaning the stale, damp air is constantly pulled out and away from the crawlspace. As you are dealing with two different crawlspaces which may or may not be connected, two fans might be appropriate here. The fan would be connected to a vent that would exhaust the air away from the house. This could be the most cost-effective solution to the musty smell. The fan(s) and vent(s) would have to be sized correctly to ensure that the correct volume of air is displaced.

Plumbing leaks in the bathroom and in the kitchen and a water leak in the sunporch ceiling should be addressed to reduce the moisture levels and possible mold growth that is a possible cause of the musty odour encountered when you open the cottage.

Slab on grade may have some moisture migration if there was no moisture barrier installed below it. This could be responsible for the lifting of the tiles in this area. One recommendation is to remove all the floor tiles, which could be hindering the evaporation of moisture that is coming through the slab. The tiles could be damp and causing odours because of mold growth on the underside.

The smell of oil in the house could be reduced by installing a combustion air feed in the furnace room. Also, weatherstripping and a door sweep on the furnace room door could reduce the amount of fumes that are pulled into the living space. Significant air sealing work will change the performance of your furnace, and could cause backdrafting without the combustion air feed and weatherstripping.

Medium Cost Recommendations

Plumbing and water leaks that require professional help will obviously increase the cost of the repairs.

Another option for the floor slab would be to seal the slab with a waterproofing product. This would have to be applied when the slab was dry (difficult to determine) and all furniture, equipment and fixtures would have to be removed.

High Cost Recommendations

Accessing the crawlspaces under the original portions of the house may be done from the floor above. This would entail removing the furniture and fixtures, the wood floors (if this is carefully done, they can be re-installed with minimal cost) and the subfloor. This gives you a chance to inspect the condition of the sills (which are under a larger load than originally intended) as well as address the dirt floors. Isolating the house from the crawlspace is done differently than if you were able to do the work from below.

Another way of doing this would be to tear up the floors and fill the crawlspaces with gravel, run a moisture barrier throughout (including over the existing slab on grade area) and pour a concrete slab over the whole ground floor area.

Upgrade the oil furnace to a new direct-vent model will reduce the smell of oil in the house. The existing furnace is at the end of its useful life, and should be replaced before it becomes a health hazard.

Summary

The musty smell seems to be coming from the crawlspace under the original portion of the cottage. The simplest solution would be to install a quiet, low-speed exhaust fan in the crawlspace (and perhaps in the two-storey crawlspace as well), ducted to the exterior. This fan would be run continuously to keep the crawlspace depressurized.
More costly ways of dealing with the crawlspaces include tearing out the main floor and installing insulation and a moisture barrier or filling the crawlspaces with gravel and pouring a concrete slab throughout the ground floor of the house.
As there is no moisture barrier under the existing slab on grade area, leaving the concrete floor open to the air (ie, taking up the lifted vinyl tiles on slab area) would allow it to dry out somewhat. Remedial action can be taken once the slab is drier.
Fixing plumbing and ceiling leaks can reduce the chances of further musty smells and mold growth.

We look forward to working with you to find a viable solution to the moisture problems in this house. We will be contacting you shortly to set a time for a meeting between you and the project team to further discuss the

possible solutions.

July 10, 2004

Following our site visit of June 22nd, we have revised our recommendations as follows. We would like to discuss these recommendations with you to ensure that they work with your plans for the house.

In general, the dirt-floored crawlspaces are the most likely cause of the musty odours you have been experiencing in the house, especially over the original cottage area. The first recommendation we would make is to block off the crawlspace vents on the east and west side of the house, as they are extremely close to the grade, and are most likely adding to the moisture level, not reducing it. Leave the two vents that are higher above grade open. To ensure ventilation of the crawlspace, install a 200 to 250 cfm fan in the crawlspace area through one of the sealed ducts on the west side (for easy access). Run constantly, or controlled by a humidistat, this fan will depressurize the crawlspaces and reduce/eliminate the airborne moisture transfer from the crawlspaces to the house. This will not dry out the crawlspace floors, however, and as it looks as though some of your structural members are sitting directly on the dirt, you may want to look at more costly – and more complex -- solutions at a later date.

For the immediate future, an inexpensive, high-efficiency should do the trick. A fan with a 200 to 250 cfm capacity should work. We will re-visit the house prior to any work being completed and ensure that this size fan is actually strong enough to depressurize the crawlspace before it is installed. This will require coordinating with your installer.

Plumbing leaks in the bathroom and in the kitchen and a water leak in the sunporch ceiling should be addressed to reduce the moisture levels and possible mold growth that is a possible cause of the musty odour encountered when you open the cottage. The flat roof above the sunporch shows signs of pooling water. This could become a major leakage problem.

The slab on grade may have some moisture migration if there was no moisture barrier installed below it. This could be responsible for the lifting of the tiles in this area. One recommendation is to remove all the floor tiles, which could be hindering the evaporation of moisture that is coming through the slab. The tiles could be damp and causing odours because of mold growth on the underside.

Another option for the floor slab would be to seal the slab with a waterproofing product. This would have to be applied when the slab was dry (difficult to determine) and all furniture, equipment and fixtures would have to be removed.

The smell of oil in the house could be reduced by installing a combustion air feed in the furnace room. Also, weatherstripping and a door sweep on the furnace room door could reduce the amount of fumes that are

pulled into the living space. Significant air sealing work will change the performance of your furnace, and could cause backdrafting without the combustion air feed and weatherstripping.

If you are planning to use the house as a full-time residence, then there is merit in looking at re-working the foundation under the two crawlspace areas. Accessing the crawlspaces under the original portions of the house may be done from the floor above. This would entail removing the furniture and fixtures, the wood floors (if this is carefully done, they can be re-installed with minimal cost) and the subfloor. We did notice quite a bit of play in the stiffness of the floor in the original cottage area, to the left of the fireplace, so there may be some structural rot, or perhaps a beam or bearing point was severed during a renovation. Opening up the floor gives you a chance to inspect the condition of the sills (which are under a larger load than originally intended) as well as address the dirt floors. Isolating the house from the crawlspace is done differently than if you were able to do the work from below, and the results could be less than perfect, meaning you could have musty smells and moisture issues anyway.

Another way of doing this would be to tear up the floors and fill the crawlspaces with gravel, run a moisture barrier throughout (including over the existing slab on grade area) and pour a concrete slab over the whole ground floor area.

Upgrade the oil furnace to a new direct-vent model will reduce the smell of oil in the house. The existing furnace is at the end of its useful life, and should be replaced before it becomes a health hazard.

We look forward to working with you to find a viable solution to the moisture problems in this house. We will be contacting you shortly to set a time for a meeting between you and the project team to further discuss the possible solutions.

10.8 WEATHERIZED HOUSE: MSTNSD68

May 10, 2004

No Cost/Low Cost Recommendations

The propane appliances are offgassing and not burning cleanly. To improve performance, have the appliances inspected and serviced on a regular basis.

Kerosene lamps do not burn cleanly. The house should be well-ventilated when these are lit. Carbon marks on the ceilings from the kerosene and propane lights indicate that the lighting needs adjustment to burn more efficiently.

Remove tar paper from under area rugs in kitchen.

Seal off trap door to basement to reduce odours and moisture coming into the main part of the house.

Remove all loose wood and other items from the basement, as it is a good growth medium for mold.

Open soffits (the area under the eaves) are of concern for moisture penetration into the house (blowing snow and rain could get into the attic and dampen the ceiling, causing mold growth).

General clean up of upstairs area to remove old boxes, mattresses and carpets and bedding. Suggest not storing bedding in the house, or storing it in airtight containers. All soft surfaced items that show evidence of mold growth or stains should be removed and disposed of to avoid further mold growth.

Seal off loose fiberglass in the upper floor to reduce the levels of particulate matter in the air (this will also reduce dust levels).

Basement moisture problem :

Address water control issues first. There is enough seasonal water on the floor to cause moisture problems (most likely this happens during the spring but it was damp in the fall when the site visit was made). This could be done by hand-digging a trench around the perimeter and one strip down the middle of the basement and installing drain tile (‘big O’ perforated plastic pipe) laid in gravel in the trench. The trenches should be sloped to the cellar door where the water can be easily carried to the exterior. The drain tile should be connected to a solid pipe laid in a gravel-lined trench on the exterior, sloped away from the house and below

the floor surface. This drainpipe should follow the natural slope of the hill to either a dry well (a 6 foot pit filled with free-draining gravel) or a natural drainage ditch. If the end of the pipe is left exposed at a drainage ditch, it should be covered with screen to keep rodents and bugs out.

After the drainage trenches have been installed, lay 6" gravel on top of the original dirt floor and cover this with a heavy polyethylene moisture barrier. Overlap the seams by at least 12 inches and use caulking to seal them together. Run the polyethylene up the walls at least 6 inches, but do not seal the edges to the walls. To protect the moisture barrier from any foot traffic, lay down pea gravel or paving stones in a 2 to 3 inch layer of sand.

Windows had condensation and evidence of mold growth at the time of the site visit. These single-glazed units could be refitted with a tight-fitting permanent interior or exterior storm window. The window should be sealed with caulking or waterproof silicone to reduce any air and water leakage at the frame.

All interior surfaces and fixtures that have evidence of past or present mold growth should be removed from the house (where possible), cleaned thoroughly as per CMHC guidelines (a copy of these included in this package) and reinstalled. When mold is cleaned from living space walls, ceilings and/or window frames, the woodstove should be fired up to dry the house out quickly.

Medium Cost Recommendations

There is no eavestroughing on this house. Install eavestroughing with downspouts connected to rainwater leaders that carry the water away from the house.

If the remedial work in the basement does not completely remedy the condensation problems on the windows, replace existing windows with double glazed fixed units in vinyl frames, or install interior or exterior storms. These units must be well-sealed against water and air infiltration.

High Cost Recommendations

If moisture problems continue even after the low and medium cost solutions are in place, the foundation will have to have work done on the exterior. This would entail an excavation of the foundation, new exterior drain tile installed with positive drainage away from the foundation. Install rigid board insulation (of a type approved for sub-grade use) against the whole height of the exterior of the rubble foundation, damproof with a material approved by the manufacturer, and backfill with free-draining gravel. The final grades should slope away from the house on all sides at no less than 2% grade. Where you have windows close to the finished grade in the basement, window wells with good drainage to the perimeter drain tile could be installed as well.

Summary

The bulk of the moisture and mold problems are emanating from the basement. Sealing off the dirt floor and addressing the drainage issues in the basement will go a long way to reducing the musty smells and mold growth found in the house, as will eavestroughing fitted with rainwater leaders. Cleaning visible mold from all surfaces in the house will reduce the chances of future growth. We look forward to working with you to find a viable solution to the moisture problems in this house. We will be contacting you later this month to discuss a good time for you to meet with the project team.

June 30, 2004

As per our site visit and discussion, we have revised our recommendations as follows.

Recommendations

Focus on dealing with the basement and installing eavestroughing.

The work in the basement includes clearing out the wood and other stored items in the basement as well as finishing the drainage work that has been started (ie, drain in place). Seal off trap door to basement to reduce musty odours and moisture coming into the main part of the house. This could be as simple as weatherstripping around the opening to the basement that the plywood cover sits on. With the weight of the items that are usually stored on top of this cover, there should be a decent air seal. Block off any openings in the cover with a solid, impermeable surface.

Dig a trench around the perimeter and one strip down the middle of the basement and installing drain tile ('big O' perforated plastic pipe) laid in gravel in the trench. The trenches should be sloped to the existing solid drain pipe in the front left corner of the basement. The drain tile should be connected to this solid pipe (which should lay in a gravel-lined trench on the exterior, sloped away from the house and below the floor surface). This drainpipe should slope away from the house to either a dry well (a 6 foot pit filled with free-draining gravel) or a natural drainage ditch. If the end of the pipe is left exposed at a drainage ditch, it should be covered with screen to keep rodents and bugs out

After the drainage trenches are installed, lay 6" gravel on top of the dirt floor and cover this with a heavy polyethylene moisture barrier. Overlap the seams by at least 12 inches and use caulking to seal. Run the polyethylene up the stone walls at least 6 inches, but do not seal the edges to the walls. To protect the moisture barrier, lay down pea gravel or paving stones in a 2 to 3 inch layer of sand.

Re-grade the house (tear away the old bale/organic matter that was used to insulate the house) so that the finished grade starts below the first course of dressed stones at the top of the foundation wall. Ensure that the finished grade on all sides slopes away from the house.

Eavestroughing will redirect excess surface water away from the stone foundation and help keep the moisture levels lower in the basement. Open soffits (the area under the eaves) are of concern for moisture penetration into the house (blowing snow and rain could get into the attic and dampen the ceiling, causing mold growth). This could be dealt with at the same time as the eavestroughing.

All windows should be fitted with tight storms. The single-hung windows should be sealed with strippable caulking or waterproof silicone to reduce any air and water leakage at the check rail (where the two pieces of glass in their frames meet).

Indoor Air Quality Recommendations

The propane appliances are offgassing and not burning cleanly. To improve performance, have the appliances inspected and serviced on a regular basis.

Kerosene lamps do not burn cleanly. The house should be well-ventilated when these are lit. Carbon marks on the ceilings from the kerosene and propane lights indicate that the lighting needs adjustment to burn more efficiently.

Remove tar paper from under area rugs in kitchen.

General clean up of upstairs area to remove old boxes, mattresses and carpets and bedding. Suggest not storing bedding in the house, or storing it in airtight containers. All soft surfaced items that show evidence of mold growth or stains should be removed and disposed of to avoid further mold growth.

Seal off loose fiberglass in the upper floor to reduce the levels of particulate matter in the air.

All interior surfaces and fixtures that have evidence of past or present mold growth should be removed from the house (where possible), cleaned thoroughly as per CMHC guidelines (a copy of these included in this package) and reinstalled. When mold is cleaned from living space walls, ceilings and/or window frames, the woodstove should be fired up to dry the house out quickly.

High Cost Recommendations

If moisture problems, the foundation will have to have work done on the exterior. This would entail an excavation of the foundation, new exterior drain tile installed with positive drainage away from the foundation. Install rigid board insulation (of a type approved for sub-grade use) against the whole height of the exterior of the rubble foundation, damproof with a material approved by the manufacturer, and backfill with free-draining gravel. The final grades should slope away from the house on all sides at no less than 2% grade. Where you have windows close to the finished grade in the basement, window wells with good drainage to the perimeter drain tile could be installed as well.

Summary

The bulk of the moisture and mold problems are emanating from the basement. Sealing off the dirt floor and addressing the drainage issues in the basement will go a long way to reducing the musty smells and mold

growth found in the house, as will eavestroughing fitted with rainwater leaders. Cleaning visible mold from all surfaces in the house will reduce the chances of future growth. Please contact myself or Pat Murphy if you have any questions as to how to go about this work. We have included a few ‘best practices’ drawings and notes for the basement work.

10.9 WEATHERIZED HOUSE: MSTNSD86

June 7, 2004

No Cost/Low Cost Recommendations

Overwhelming smell from gasoline stored in basement. This and all other petroleum products, motors and other equipment should be kept in a locked shed or chest outside of the building envelope. There could be mold or mildew problems that are being masked by the smell of the gasoline.

There was evidence of mold growth and rodent droppings in the main part of the house.

Remove wood and other items stored in the basement. Wood stored inside the building is one of the major culprits of mold growth.

General clean up of main floor and basement to remove boxes, musty upholstered furniture, mattresses and bedding. Suggest not storing bedding in the house, or storing it in airtight containers. All soft surfaced items that show evidence of mold growth or stains should be removed and disposed of to avoid further mold growth.

Store food in metal or plastic bins that are rodent-proof.

To reduce the amount of condensation on the windows, when closing up the cottage, install temporary interior storms (‘shrinkwrap’ for windows). This will stop air leakage and make the ‘first condensing’ surface outside the building envelope.

Ceiling around the attic hatch in bedroom #2 had a large patch of old mold growth staining. This doesn’t look like it is active, but should be cleaned away to ensure that there is no subsequent growth in this area. To reduce possibility of further mold growth, insulate attic hatch to same levels as ceiling, weatherstrip and close tightly with hook and eye fasteners to ensure there is minimal air leakage and moisture transfer here.

Unfinished drywall should be painted as soon as possible to protect it from any moisture or dampness.

Close off 4” vents in basement to reduce moisture loading in humid times of year.

Medium Cost Recommendations

Sump in basement should have a tight-fitting cover installed on it to reduce the moisture levels in the house. This can be a gasketted wooden cover held down by hook and eye fasteners.

Condensation was noted on windows during the site visit. Install a bath fan with a humidistat control to reduce the moisture levels in the house during the closed season.

Running a dehumidifier in the basement during the seasons of usage will help keep the moisture levels down (do this only after the vents are sealed).

High Cost Recommendations

You are contemplating installing electric baseboard heaters. To best control this heat, install high-performance thermostats. If it is feasible, running the heat through the winter at a lower temperature (13.5°C/55°F) will keep the house out of the range of ambient moisture problems.

Summary

Remove all soft-surfaced and porous materials from the basement to eliminate good mold growth surfaces. Clean out the main living space of all old paper, magazines, and must-smelling furniture.

Food should be stored in rodent-proof containers to reduce or eliminate the critter visitations.

Condensation on windows during the winter can be controlled by installing ‘shrinkwrap’ storms on the interior of the house.

Keep the basement vents closed. In the summer, they only bring humid air into the basement.

A bathroom fan connected to a humidistat can also reduce the moisture levels in the house during the winter. Use a dehumidifier in the basement to reduce moisture levels in the summer when the basement vents are closed.

If electric baseboard heaters are installed, it may be feasible to run them through the winter at a low temperature to keep the house from experiencing extreme fluctuations in temperature and moisture levels.

We look forward to working with you to find a good solution to the moisture problems in this house.

11 Field Study Protocol

1. Confirm homeowner participation, book site visit and mail out IAQ questionnaire. Finalize waiver/permission forms.

2. Conduct EGH and IAQ investigation of each house. The protocols for these investigations are well-documented through the Office of Energy Efficiency and CMHC's IAQ investigators program. Evaluation to include pictures of the site in general as well as the main elevations of the building and evidence of mold/condensation. A photo list form will be supplied to field researchers. More detail on the state of each house will be gathered during the course of the EGH and IAQ invesigations. Homeowners will be asked about winter access and will be asked to sign waiver forms allowing or disallowing publication of photos, as well as general understanding of the scope of the work being carried out for this study (ie, Abri Sustainable Design, its agents or representatives are not carrying out any repairs, renovations or other modification to the building, nor is there any guarantee that the solutions being suggested will be successful.) Permission to revisit property will be asked for at this time as well. Determine viable cost range for solution options (ie, what homeowners are willing to pay, generally).

3. Discuss choices of houses for further monitoring. Parameters include: power/no power, insulated/non-insulated, range of problems (from musty to serious mold/condensation presence), house type, foundation type, heating systems and ventilation systems.

4. Revisit four of twelve homes to install temp/RH monitors.

5. Download monitors in January and again in April/May.

6. Discuss choices for solutions with project team and homeowners in conjunction with analysis of EGH/IAQ investigation and results of monitoring data (ongoing discussions). Some solutions that have already been raised by homeowners include adding a bathroom fan to the building (the issue becomes what size fan with what type of control would be best to reduce moisture issues). Another solution to explore for no-power houses (or those with power shut down over winter) is a passive ventilation scheme. Other straightforward building envelope solutions might be in order for certain buildings.

7. Over the Summer 2004, solutions to be carried out.

8. Monitors in place again by Nov 30, download May 2005.

9. Analysis of variations in T and RH for those houses monitored as well as anectodal evidence from homeowners who carried out suggested solutions.

Visit our home page at www.cmhc.ca