



# Building Envelope Survey

In partnership with the City of Calgary  
April 2008



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## Summary

This report summarizes the observations from a field survey conducted in August of 2007 of homes and condominiums. This survey was conducted in response to homeowner concerns with the construction quality of their homes because of moisture penetration of the outer walls and ceilings (known as the “building envelope”).

The scope of the survey team’s work included building envelope complaints and issues for both single and multi-family housing. Observations from the survey were compared to the requirements of the Alberta Building Code and industry’s moisture control program for improvement of stucco workmanship and prevention of moisture penetration.

The survey found the homes examined generally did not meet the requirements for the building envelope in the Alberta Building Code and that industry’s moisture control program did not improve building envelope installation quality and code compliance in these homes. Buildings meeting the requirements of the Alberta Building Code do not as a rule experience moisture penetration or damage.

The survey team’s observations demonstrate a need for government, municipal and residential construction industry representatives to take steps to safeguard the quality and integrity of new home construction in Alberta as it relates to the building envelope. Findings from this study involve the provision of more technical advice and information on building envelope issues to municipal and industry officials as well as further emphasis on the building envelope in regulation.



## Findings

Observations from the survey are expected to contribute to a better understanding of residential building practices, the effect of warranty programs and current industry initiatives to limit moisture penetration of the building envelope. A set of core findings were identified to further this understanding.

### *Finding 1: Accountability of the Construction Industry*

**Builders, warranty programs and other construction stakeholders should adopt best practices and take greater responsibility for full compliance with the Alberta Building Code. Suggested strategies for improvement:**

- Improve and expand industry moisture control programs by involving the designers in the program and using a building envelope specialist to approve building envelope work.
- Review the Warranty Programs on a regular basis to take current construction issues into account including revising the coverage for the building envelope beyond the norm of one year.
- Change the management of the construction process to ensure appropriate supervision of the sub-trades on residential projects.
- Engage professional architect and engineer associations in reviewing the education of professionals with regard to professional schedules under the Alberta Building Code.

### *Finding 2 - Consumer Protection and Recourse*

**The Government of Alberta's ability to fulfill its administrative duty to protect the safety and welfare of Albertans should be enhanced.**

**Suggested strategies for improvement:**

- Establish mandatory new home warranty coverage for the Province through Service Alberta and continue to build upon the education initiatives developed and accepted under Service Alberta's March 2006 report "*Assurances and Recommendations Concerning Client Service Issues in Alberta's New Home Warranty Industry*"
- Compare, through Service Alberta, Alberta's consumer protection programs to other jurisdictions for residential construction and determine where there are areas for expanding protection for consumers from fraudulent or non-performing contractors and warranty programs.
- Require builders to post bonds to secure the satisfactory completion of common elements of construction or those elements not covered by warranty law.

### *Finding 3: Appropriate Trade Certification and Skills*

**Existing training and apprenticeship programs warrant review by the Ministry of Advanced Education and Technology, or new training programs for trades in the residential construction industry should be developed.**

**Suggested strategies for improvement:**

- Evaluate the findings of the Canadian Home Builders Association April 2006 report "Labour and Human Resource Working Paper for the Alberta Residential Construction Industry" calling for a comprehensive manpower strategy for residential construction in Alberta for information that may assist in developing new or enhanced programs.



- Establish regulatory or certification mechanisms for trades critical to new home construction including those that work on the building envelope (framing, roofing, wall cladding, window installation etc).

*Finding 4: Appropriate Inspection and Enforcement Process*

**The adequacy of municipal safety code inspections during the construction phase warrants review by Municipal Affairs and the Safety Codes Council.**

**Suggested strategies for improvement:**

- Analyze the issues identified in Service Alberta's March 2006 report "*Assurances and Recommendations Concerning Client Service Issues in Alberta's New Home Warranty Industry*" related to the value of inspections, including at the building envelope stage of construction.
- Review the appropriateness of Quality Management Plans that govern the frequency, timing and scope of municipal inspections.
- Increase penalties for violations of the *Safety Codes Act* to make them effective deterrents to non-compliance with the building and other safety codes.
- Foster continuing co-operation among the residential construction industry, homebuyers and municipal safety officials over the resolution of building envelope disputes to reduce litigation and mitigate unsafe conditions.
- Develop interpretive and educational support for the correct application of the building envelope.



## Background

Issues regarding stucco thickness and moisture penetration were brought to the attention of builders and regulators by a 2003 Morrison Hershfield consultant report. The Morrison Hershfield report noted that only 15 per cent of the buildings surveyed met the required thickness for stucco under the Alberta Building Code, and a number of moisture penetration problems were also identified. In late 2003, the Alberta branch of the Canadian Home Builders Association introduced a series of initiatives to improve stucco workmanship and moisture control or moisture prevention for residential housing. These initiatives included a Moisture Technician Course, a Moisture Smart Program, and the Stucco Resource Guide. In January 2004, an information bulletin was issued by the department of Municipal Affairs and the Safety Codes Council to highlight the Morrison Hershfield findings and the housing industry's plans to address this issue.

Municipal Affairs has received an increasing number of complaints related to apparent failure in the outer layer of residential buildings, also known as the "building envelope." The City of Calgary has also received similar complaints and has adopted an approach of establishing teams to survey issues that impact the administration of the *Safety Codes Act* in their jurisdiction. These complaints have resulted in concern that the initiatives introduced by the home building industry in 2003/2004 have not addressed the building envelope issues identified by the Morrison Hershfield report.

In August 2007, The Minister of Municipal Affairs approved a joint Municipal Affairs/City of Calgary survey because the City of Calgary offered a broader sample of the issues to be surveyed. The joint survey with the City of Calgary of completed and under construction housing was designed to improve Municipal Affairs' and the city's understanding of building envelope issues.



## Methodology

### *Phase I:*

The City of Calgary contracted with a building science consultant to survey a sample of single family and multi-family dwelling units completed from 2003 to the present day. This time period corresponds to the implementation of the home building industry's moisture control programs and initiatives. The consultant led a joint team of City of Calgary and MA&H building officials to survey sites where apparent failures have occurred in the building envelope. Approximately 15 single family and five multi-family dwelling units formed the basis of the survey sample. Other conditions of the home were considered as it relates to the building envelope.

### *Phase II:*

The City of Calgary and MA&H building officials surveyed a random sample of new home (single and multi-family) construction where the building envelope was at the installation stage. The purpose was to observe the early stages of the building envelope and consider any linkages to the types of failures surveyed in the first phase.

### *General Findings:*

Analysis of both Phase I and Phase II samples indicates that builders are not complying with the requirements for the building envelope in the Alberta Building Code and that the Moisture Control Program has not improved building envelope installation quality and code compliance. Phase II sites indicate that the failures observed in Phase I (completed construction) are being repeated in new construction. All sites observed demonstrated incomplete and deficient construction below the standard required by the Alberta Building Code.

Homeowners who experienced building envelope failure raised concerns about the lack of accountability for builders to conform to the Alberta Building Code, the infrequency or absence of inspections by the municipality, insufficient coverage and support by home warranty programs, inadequate consumer protection and compensation, and the failure of enforcement measures by both the municipality and provincial consumer services programs.

The City of Calgary also raised concerns regarding the lack of certified trades for building construction, poor workmanship, the influx of new and untested materials and designs, the need for greater emphasis on the building envelope in the Alberta Building Code, and lack of follow up by professional architects and engineers on residential building projects. Litigation was also identified as key obstacle to resolving issues between owner and builder, and is increasingly absorbing the time and resources of the municipality.

Overall, the survey indicated that the Alberta Building Code requirements are not at issue. The primary reasons for building envelope failure for both single and multi-family homes are related to poor construction practices and trade skills, lack of accountability within the building industry and insufficient or ineffective inspections/enforcement by municipal authorities.



## Key Observations

The construction of a home is a complex process that begins with a design, continues with permits for development and permission to build, proceeds through to construction and concludes with an inspection and permission for the owner to occupy the home. The survey team observed issues at all phases of home construction that contributed to the building envelope failure.

### *Design Issues*

Building exteriors have become increasingly complex involving many different types of cladding, buildouts, jogs in walls, architectural bands, decks etc. Although the designs are in compliance with the building code, the process of construction is affecting the performance of the building envelope.

#### **Example:**

The use of pre-fabricated materials is becoming more common in both residential and commercial construction. This practice is creating issues because the final design of the home is not known when the materials are manufactured and designed. It was observed in some of the survey samples that pre-fabricated materials were not fitted together properly, leaving gaps in the building envelope for moisture to penetrate. Another observation is that pre-fabricated materials that do not fit together may be modified on the site through the use of duct tape, staples or adjustments to the material itself.

### *Product Application*

It was observed that the municipality is accepting new products for application in the building envelope on the authority of an engineer's stamp. The authority having jurisdiction will ask for Canadian Construction Materials Centre (CCMC) evaluation for the product, and if no CCMC evaluation is evident or if it is refused by the builder, an engineer's stamp is accepted in lieu for each site. An engineer's review and stamp may not be equivalent to a CCMC evaluation or may not address in sufficient detail the performance of the material in the building envelope.

#### **Example:**

The EIFS (Exterior Insulated Finish System), an acrylic stucco application, is gaining in popularity for small residential projects. Not all variations of this system fall within the scope of the code and require professional involvement. Several variations of this system were observed in addition to systems currently evaluated and listed by CCMC.

### *Alberta Building Code*

None of the buildings that the survey team observed that had building envelope failures were in compliance with the building code. The survey indicated that building code requirements are appropriate and not related to the failure in performance of the building envelope.

The City of Calgary did indicate that the building code could be improved by providing greater detail for window installation and building envelope issues, including greater guidance in the professional schedules that regulate professional engineers and architects for building envelope construction. Currently the code only refers to wall cladding in the professional schedules.





### *Professional Involvement*

Questionable construction practices were observed, which suggest that professional review was not being performed, such as the use of shipping material for building paper. Professional review of building envelopes may be lacking on larger or multi-family projects. Most single family homes do not require professional involvement, but it was observed that smaller housing projects deviate from the code even though professional involvement occurred.

The City of Calgary specifically raised the concern that professional engineers and architects are increasingly failing to meet their own professional standards for performance. For example, the lack of follow up by a professional on the project has become a more frequent practice, with the result that the construction of the home deviates from the original design or review of the professional.

### *Workmanship*

The quality of workmanship observed was unacceptable, which in many of the samples appears to be a direct cause of envelope failures. Non-compliance with the building code that contributed to envelope failure was observed to commonly occur in three primary areas:

#### **Window Installation:**

Window installation is not being performed in accordance with manufacturer's specifications. Details are specific to each manufacturer, and for larger projects and custom windows, installations should be designed and reviewed by a professional.

#### **Flashings:**

Flashings are not being installed where required and may not comply to code.

#### **Sheathing Paper:**

Sheathing paper was observed to be missing, lapped incorrectly or with no compatible cladding material. The team also observed combinations of sheathing paper and stucco that are non-compatible, which results in the deterioration of the paper.

Other defective areas involved the continuity of the vapour barrier, especially at rim joist areas. It was observed that while attention to conformance and appropriate design of the vapour barrier has improved, design and attention to exterior envelopes has not improved.

As referenced in the Morrison Hershfield report, stucco thickness does not appear to be a contributing factor to moisture penetration of the building envelope. Although samples from Phase I were observed to be in compliance with the building code for stucco thickness, samples from Phase II or new construction were observed at 12-12.5 mm stucco thickness, as indicated by the amount of space around the windows. The Alberta Building Code allows for 2 coat stucco at 19mm thickness or 3 coat stucco of not less than 15mm thickness. The 3 coat stucco is required to be measured from the face of the lath or masonry, which typically means close to 19mm thickness in practice. There are concerns that stucco thickness that is less than the building code standard is more susceptible to cracking and deterioration, which exposes sheathing paper to weathering and sunlight and reduces moisture protection.



### *Trade Skills and Qualifications*

In Alberta, certain construction trades are not certified disciplines and the high construction rate has resulted in the use of unskilled labour for work that traditionally would require skills and experience gained through apprenticeship training and certification. The survey observations of poor workmanship also identified a relationship between lack of appropriate trade skills and qualifications for residential construction.

In an environment with evolving technology and constantly changing construction methods and materials, specially trained and skilled expertise may be required on-site at all times. There are indications from building envelope experts and the observed sites that contractors and subcontractors employ labourers without proper supervision on construction tasks for which they are unskilled or unsuitable.

The Canadian Home Builders Association (CHBA) also identified this problem in their April 2006 “Labour and Human Resource Working Paper for the Alberta Residential Construction Industry”. This paper observed that there is not a comprehensive manpower strategy for residential construction in Alberta, which directly impacts training, education and performance.

### *Moisture Control Program*

Observations for both Phase I and II indicate that the Moisture Control Program and resource tools are not effectively used by industry and in some cases entirely abandoned. Resource tools include a checklist of regulatory and workmanship requirements and contractor qualifications and responsibilities. In particular, there is a requirement for the Stucco Resource Guide Substrate checklist to be completed by the stucco contractor and submitted to the builder before weather resistant membrane and wire installation begins. Even with these measures, the Moisture Control Program does not appear to have changed or improved the practices for building envelope prior to the introduction of the program in 2003/04.

Neither the designers nor the supervisors, the individuals who could have a more substantial impact on the effective use of the program, are involved on construction sites. It was observed that there is a disproportionate reliance on the sub-trades, who do not control or supervise the overall building project for building envelope quality and accountability.

### *Municipal Inspection Services:*

The survey team discussed the adequacy of municipal safety code inspections during the construction of a home. The minimum number of inspections, the type of work inspected, and when the inspections occur are requirements outlined in the Quality Management Plan approved for each municipality. The survey team observed that the inspection of the building envelope is not a required or identified stage in most Quality Management Plans for municipalities in Alberta.

The City of Calgary observed that it is impossible for all elements of construction to be inspected with limited resources. This is particularly the case for the building envelope, as construction occurs in stages so that the work is often completed in part or whole by the time an inspector is on site. Simply requiring more inspections will not solve the problem, especially as building envelope failure often occurs months or years after construction is completed.



*Other Observations:*

**Climate**

Weather conditions in the City of Calgary were noted as problematic for building envelope performance with approximately 300 freeze-thaw cycles a year and the wind factor that contributes to freeze-thaw conditions. In Calgary, walls may be failing on the windward side of home yet performing acceptably on a south wall exposure.

**Litigation**

The City of Calgary stated that a number of their inspectors spend approximately 50 per cent of their time in court or in legal proceedings as a result of litigation by the homeowner and lack of cooperation by the builder and warranty programs.

**Liability and Warranty Protection**

Estimates were around \$50,000 per wall face on an average home to remove and replace stucco and remediate mould damage resulting from moisture penetration. Homeowners complained that warranty programs do not provide adequate coverage or sufficient length of warranty to cover the damages.

Alberta New Home Warranty Program (ANHWP), Canada's first new home warranty program, is self-insured and subject to the *Fair Trading Act* (FTA). Alberta's homebuilding industry launched this enterprise in 1974 in response to concerns that were raised by Canada Mortgage and Housing Corporation and other agencies about the quality of housing that was being built in the national housing boom of that era.

The National Home Warranty Programs Ltd. (NHWP) and Progressive Home Warranty Solutions Inc. (PHWS) contracts are underwritten by insurance companies under the jurisdiction of the *Insurance Act*, administered by Alberta Finance's Deputy Superintendent of Insurance.

Alberta has no regulation aimed specifically at the new home warranty industry. Many homes are still built without warranty coverage and that coverage is less likely to be offered the further one is from urban centres such as Calgary.

In Alberta, the three programs provide homeowner protection for building code infractions in workmanship and materials during the first year and major structural defects for an additional four years. (PHWS provides this additional structural-defect coverage for an additional nine years).



### **Public Expectations**

Homeowners' expectations for the quality of their homes may be summarized as follows:

- That the workers will adhere to the contract;
- That the workers will have the appropriate skills and tools for quality construction;
- That the home will be structurally sound;
- That the home will contain sound internal systems and a sound building envelope (walls, roof, etc.);
- That the fit and finish will be similar to that of the builder's show home;
- That sound inspection processes will be used during construction;
- That the builder's intentions and practices are transparent;
- That oversights during pre-delivery inspection will be covered by the warranty when noted at a later date;
- That the builder will address claims in a timely manner;
- That there is adequate consumer protection; and
- That safety regulations are enforced in a timely manner to ensure quality construction is maintained.



## Conclusion

The survey team's observations demonstrate a need for government, municipal and residential construction industry representatives to take steps that will safeguard the quality and integrity of new home construction in Alberta as it relates to the building envelope. Although the extent and severity of building envelope issues cannot be ascertained with statistical certainty, the survey observations in the City of Calgary provide sufficient evidence for a call to action so that building envelope failure does not become commonplace.

Residential building envelope failure is not attributable to a single cause or practice. As the survey observations indicate, the system of construction and inspection is not performing adequately to protect the home or condominium owner. If the codes and standards in place to protect the public are not complied with, it leads to disastrous results. Although improper construction is to be expected from time to time, any indications of a pattern of sub-standard construction warrant attention by the Province of Alberta to ensure Albertans can have confidence in their safety system. Industry, municipalities, professions and trades, regulators and other stakeholders in the residential construction industry need to work co-operatively to address this issue. Concerted measures to protect the homeowner and enhance industry compliance are necessary for meaningful change in the quality and durability of residential construction.

Ultimately, the survey team must point out there is no substitute for the exercise of common sense, civic responsibility and awareness by those involved in the discharge of their duties on behalf of homebuyers and by the homebuyers themselves.



## Appendix—Illustration

The survey was conducted in the following areas in the City of Calgary:

Country Hills  
Coventry Hills  
Evergreen

Lower Mount Royale  
Mardalooop  
Royal Oaks

Tuscany  
Wentworth  
Aspen Woods

The following pictures are an illustration of the issues found in a particular building.



Exterior façade before removal



Moisture damage under exterior finish



Interior drywall with mould growth



Moisture content of 79% should be less than 19% (mould growth in background)



Repair to affected wall



Damaged studs and exterior sheathing



Moisture content of 73.5% should be less than 19%



Screw driver through support member



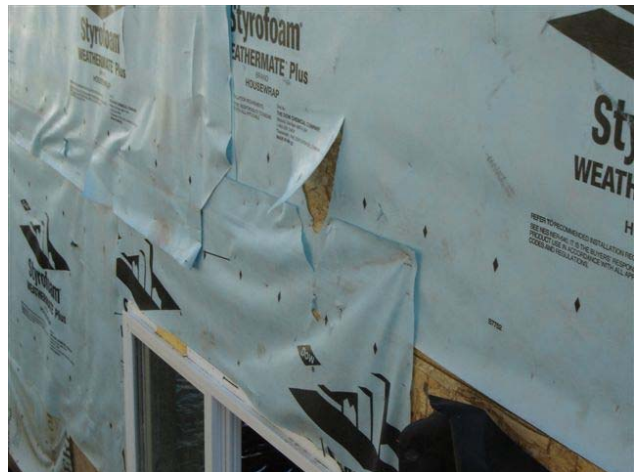
Repair to a wall facade



Damaged building paper due to prolonged exposed to weather



Improperly installed window



Torn building paper





Water damage beneath window sill



Window flange not nailed properly



Improper stucco thickness



Improper stucco thickness