BRICK VENEER/STEEL STUD WALL

DESIGN AND CONSTRUCTION PRACTICES

IN CANADA

RESULTS OF A 1986 SURVEY

Prepared for

Project Implementation Division
Policy, Research and Program Sector
Canada Mortgage and Housing Corporation

by

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This publication is one of the many items of information published by CMHC with the assistance of federal funds.

DISCLAIMER

This study was conducted by Suter Keller Inc for Canada Mortgage and Housing Corporation under Part V of the National Housing Act. The analysis, interpretations and recommendations are those of the consultants and do not necessarily reflect the views of Canada Mortgage and Housing Corporation or those divisions of the Corporation that assisted in the study and its publication.

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ABSTRACT

During the last 15 years, brick veneer/steel stud (BV/SS) walls have become widely used in Canada, as an economical building enclosure system in residential and commercial structures. However, the construction of these walls has preceded the development of adequate design, construction and inspection standards. This situation has led to concern over the longterm safety, serviceability and durability of this form of construction. This study gathers information related to design, construction and inspection aspects of BV/SS walls in Canada.

An industry survey was conducted in order to gather broadbased information and opinions regarding practices and concerns from people involved with the BV/SS wall system. However, the small number of responses received in some regions of the country and the locations of the respondents in these regions do not lend themselves to a meaningful regional analysis. This report summarizes the results of the survey and, based on the findings, identifies and establishes the state of industry concern.

The findings indicate that the BV/SS wall system has been used across the nation for an average of 8 years and that a variety of design, construction and inspection practices are employed. A need exists for some degree of formalization and standardization of the existing practices for the design, construction and inspection of the BV/SS wall system. The need for more research, education and better technology transfer is shared by the majority of respondents. Since steel stud/drywall and masonry contractors are most often involved in the installation of the BV/SS wall system, future education and technology transfer efforts should be directed primarily towards these two trades. While the issue of air infiltration has been expressed as a major concern by designers and contractors alike, corrosion of metal components as well as excessive stud flexibility have not generally been observed as major problems.

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1.0 INTRODUCTION

Brick veneer/steel stud (BV/SS) walls have become a popular and economical way to enclose a modern structure. The system is used in lowrise and mid- to highrise buildings in residential, commercial, office, institutional and industrial applications. The development of the BV/SS wall system has been perceived by some as providing:

- **Savings in Construction Costs**
  Costs less than other systems such as curtain walls or conventional masonry veneer/back-up walls

- **Economy of Space**
  Occupies less space than conventional masonry walls

- **Heat Loss Resistance**
  Achieves a better heat resistance with little or no increase in wall requirements

- **Aesthetics**
  Can satisfy current architectural tastes towards exterior brick walls

- **Reduction in Dead Loads**
  Requires lighter structural framing and foundations

- **Construction Time Reduction**
  Allows the building to be closed-in faster than with conventional masonry

- **Fire Resistance**
  Meets the NBC and other regional building code requirements.

Various opinions and practices regarding the design, construction and inspection of the system are in place as they preceded the development of a design code as well as construction standard requirements. Furthermore, the structural behaviour of the system is not yet fully understood.

This report deals with a survey of current practices for design, construction and inspection of the BV/SS wall system in Canada. In general terms, the survey collected information about materials, design and construction issues.

The information was gathered from the following four groups:

Group A: Architects and Engineers
Group B: Masonry Contractors
Group C: Steel Stud and Drywall Contractors
Group D: Building Officials and Inspectors

Table 1 provides the statistics with reference to the number of questionnaires sent to each group. The questionnaires were tailored to each of the four groups. Samples of the four questionnaires are included in Appendix A.

Table 1: General Statistics with Reference to the Number of Questionnaires

Group	Number of questionnaires sent	Number of questionnaires answered
A	306	111
B	82	23
C	41	16
D	21	10
Total	484	160

The objective of this study is to determine the state of the art of the BV/SS wall system in Canada. The survey results are summarized in Appendix B.

Prior to mailing the final version of the questionnaires, a pilot test run was carried out in the Ottawa area to ascertain that the questions were pertinent and understandable. An attempt was made to eliminate any bias in the sampling procedure and to collect a representative sample which describes the actual BV/SS wall situation in all regions of Canada.

In reviewing the survey findings, it should be recognized that there are limitations to a survey. The quality of a survey depends to a great extent on:

- population sample
- number of responses
- clarity of questions

- respondents' interpretation of questions
- interpretation of answers.

While the questionnaires were somewhat lengthy and detailed, respondents appear to have made an effort to answer the questions as completely as possible.

2.0 SAMPLING METHODOLOGY AND NATURE OF SAMPLE

The population for sampling was defined as the people and businesses in Canada involved with BV/SS walls. This population was divided into four groups as outlined in Section 1. Individuals in these groups are operating a business and/or supply service in one of the following four regions: (1) Atlantic Canada, (2) Southern Quebec and Ontario, (3) Prairie Region and Northern Ontario, (4) Pacific Canada.

The selection of individuals to be part of the survey was based on one or more of the following criteria:

- The firm or individual was found to have some experience with BV/SS walls after an interview.
- The firm or individual was referred to us by people knowing they had some experience with BV/SS walls.
- The firm or individual was listed by a construction trade association (eg. masonry, drywall, etc.).
- A number of firms and individuals were selected using random numbers and lists of names available to the public.

The nature and characteristics of the people consisting of our sample are extracted from Section I of the questionnaire. This section is common to all four groups.

Fig. 1 indicates some general statistics on respondents and their location across Canada.

As shown in Fig. 1, the majority of people surveyed are in the architectural and structural design business and are located in the Southern Quebec and Ontario region.

Of the 160 firms and individuals responding to the survey, 39 (24%) did not have any experience with BV/SS walls. The balance of 121 (76%) had some degree of experience.

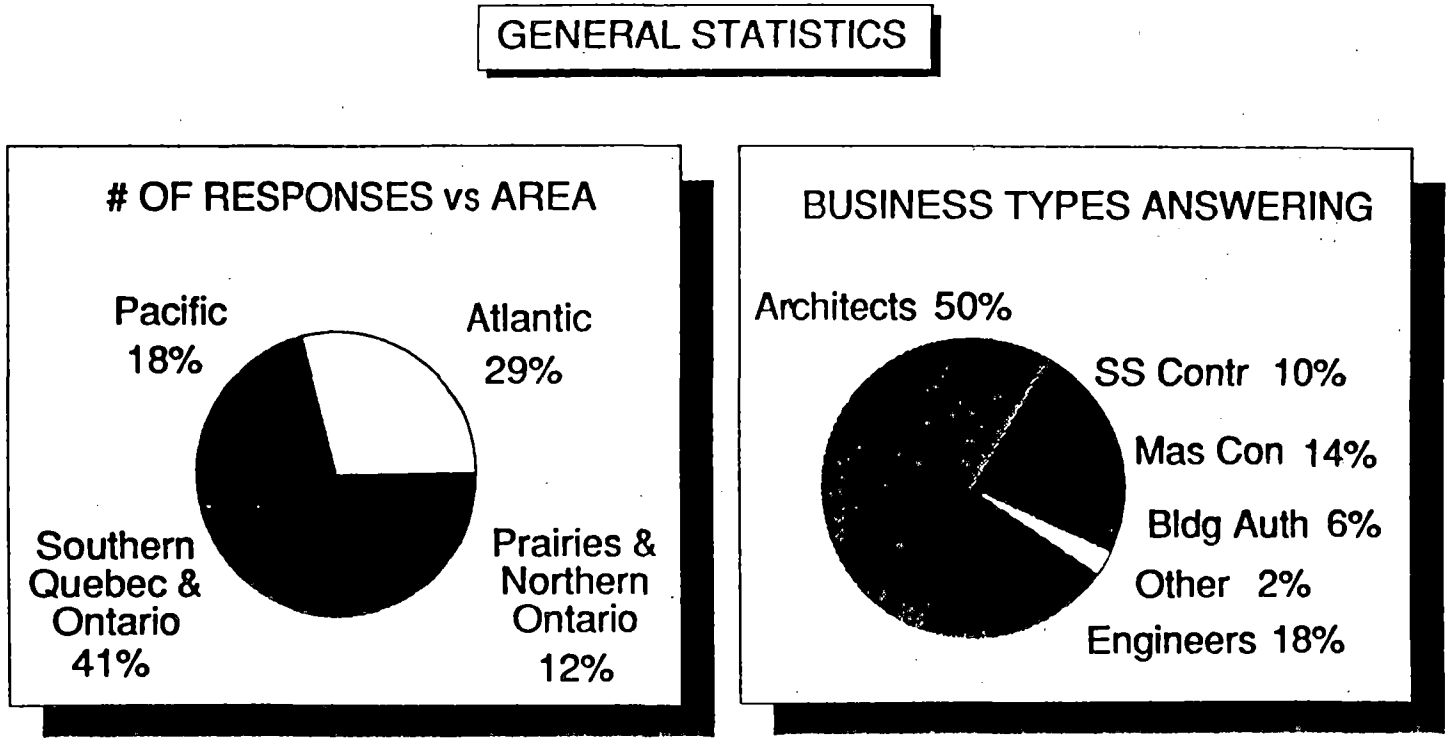


Fig. 1 General statistics on regional and business response

The respondents appear to represent collectively, BV/SS wall system experience on over 1,000 buildings. Of these, 42% were residential and 58% were commercial or industrial.

Fig. 2 illustrates some general statistics on building height, type of building system and number of years the BV/SS wall system has been employed in Canada. The survey suggests that the BV/SS wall system is more popular in buildings less than 4 storeys in height.

The statistics in Fig. 2 indicate that the BV/SS wall system has been used in Canada for approximately 8 years. While the system has been used for over 9 years in the Prairies and Northern Ontario, the Pacific region has employed it only for about 6.5 years.

3.0 RESPONSES

Respondents can be grouped into four categories according to their position with respect to the BV/SS wall system. The percentages shown in Fig. 3 are estimates derived from the respondents' comments in the questionnaires:

- Enthusiastic believers and users (mostly contractors)
- Users with some reservations
- Non-Users waiting for more knowledge and refinements on the system
- Non-Believers.

Twelve firms stated that they will simply not use the system, as they consider it to be unsafe.

Pertaining to the Non-Believers, their major concerns are as follows:

- Stiffness incompatibility between the steel stud wall and the brick veneer

- Unjustified reliance, implied in some designs and construction techniques, on the structural integrity of the gypsum wallboard as a structural material or as a spacer between the studs and the ties. What happens when the gypsum gets wet?

- Corrosion of the widely used screw connectors as they perforate the zinc coating of the studs

- Difficulty in providing an adequate air/vapour barrier for this type of construction and the resultant risk of

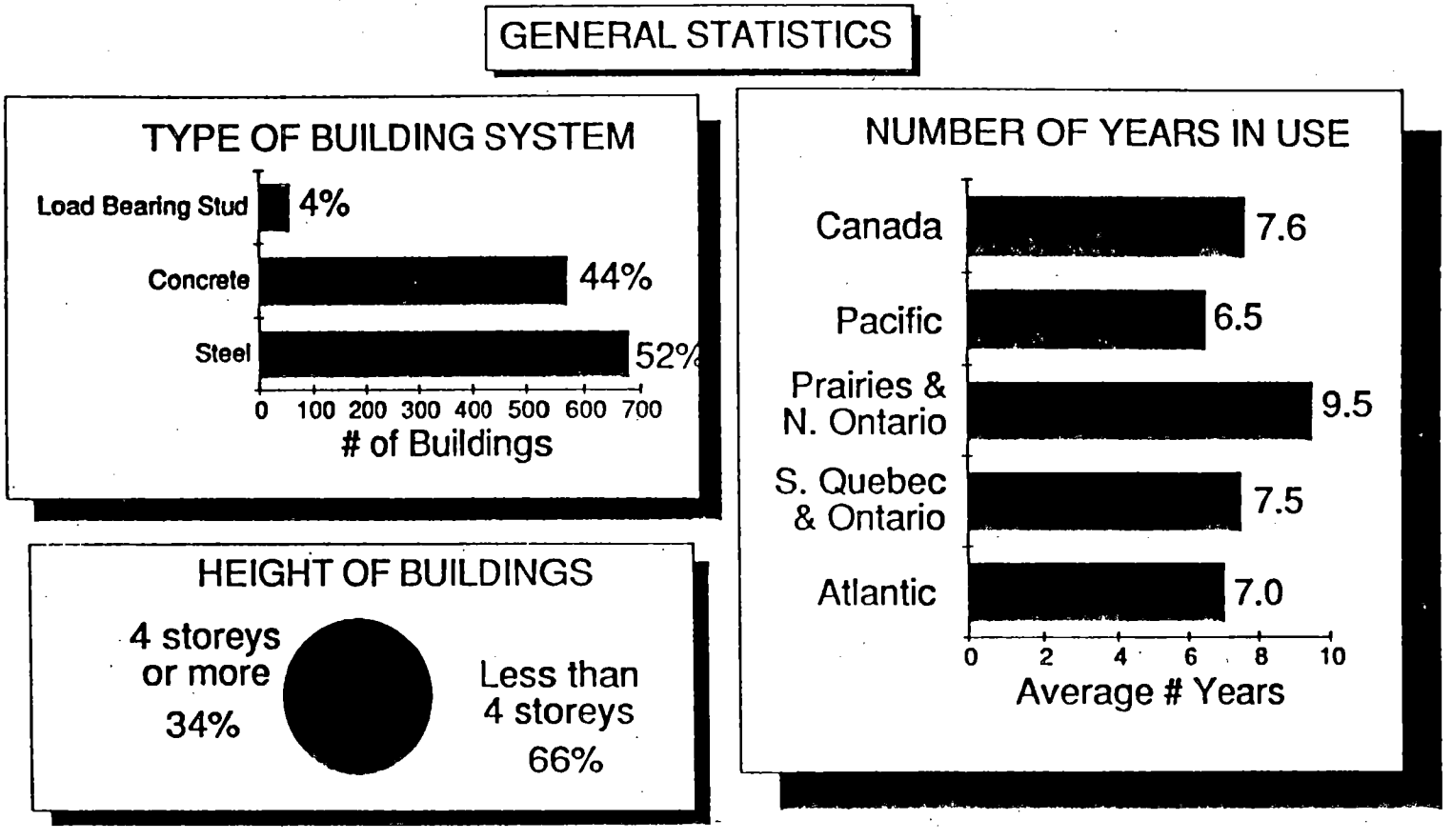


Fig. 2 General statistics building systems, building height and years of usage

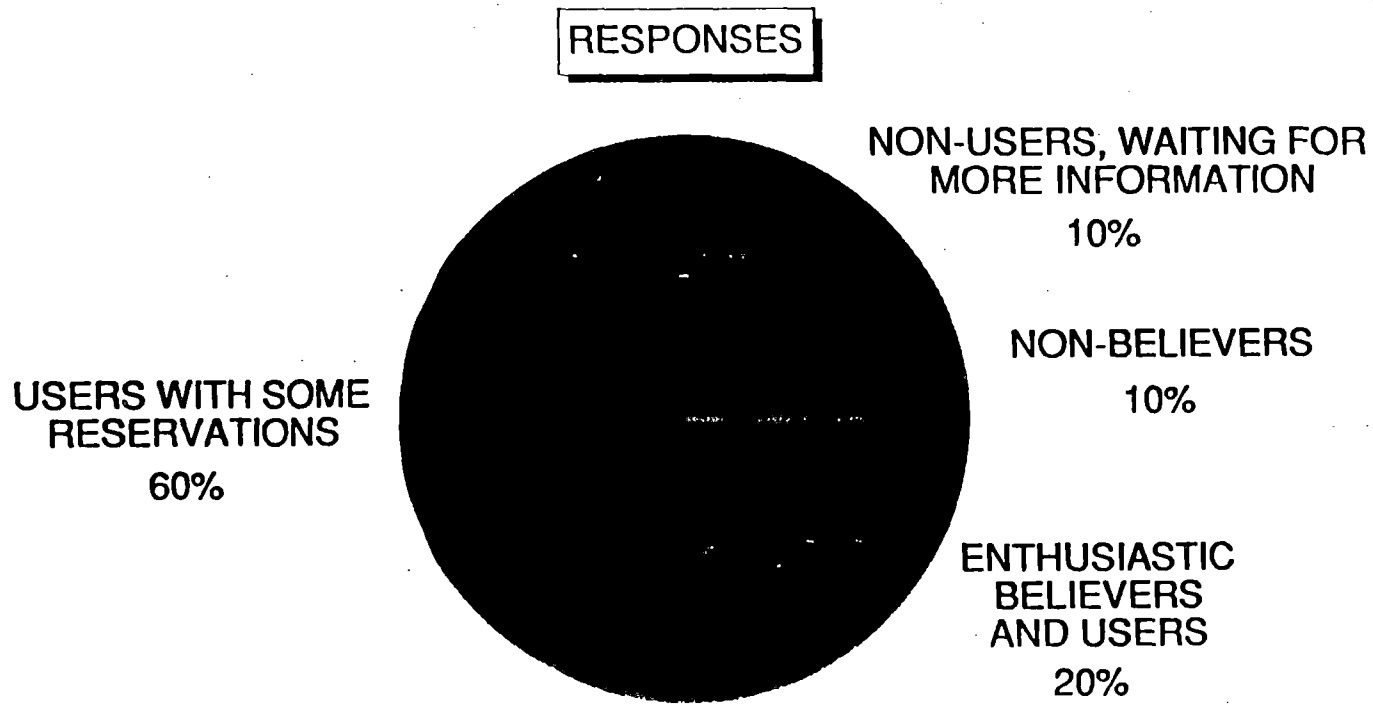


Fig. 3 Groups of responses

moisture accumulation and therefore the potential for corrosion of metal components

- Inadequate inspection practices.

4.0 DESIGN ISSUES

Fig. 4 indicates that currently more than 50% of the design professionals specify a limit of L/360 for lateral steel stud deflection under wind loading. About 20% use the more stringent requirement of L/600 and about 10% use a permissible deflection limit of L/240 or greater. L represents the height of a simply supported steel stud.

The question as to which party most frequently designs the BV/SS walls was surveyed and the findings are also included in Fig. 4. It appears that the project architect most often designs the BV/SS wall system. The project structural engineer seems to assume this responsibility in less than 30% of the cases. The survey further indicates that shop drawings are not often required in the specifications for the BV/SS wall system.

The questionnaire attempted to determine what standards or guidelines are being used in the design of the BV/SS wall system. As shown in Table 2, a wide variety of standards and guidelines are being used by designers. The survey indicates that about one third of the designers rely on product catalogues and industry publications, while another third use CSA standards, NBC and local codes. About 13% design the BV/SS wall system based on common sense and intuition.

Table 2 Currently Used Standards and Guidelines

STANDARDS OR GUIDELINES USED	PERCENTAGE
Product catalogues and industry publications.....	34
CSA standards, NBC codes and publications, local codes, CMHC reports and publications.....	27
No codes, but common sense and intuition.....	13
Structural engineer's opinion.....	8
Masonry Institute publications and literature.....	7
Architectural standards and specifications, foreign codes and guidelines.....	6
Past and current research findings.....	5

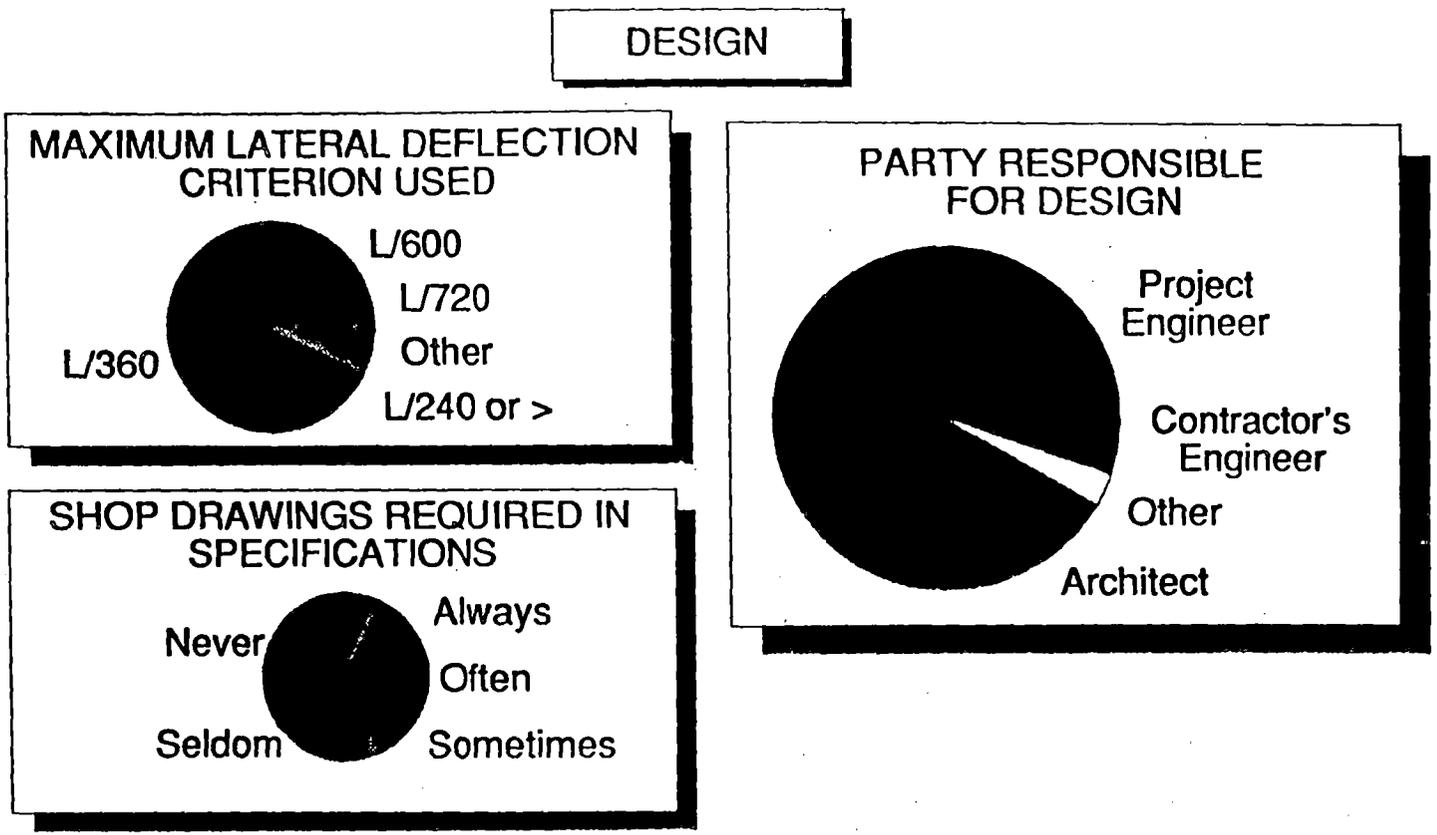


Fig. 4 Information on design related questions

5.0 CONSTRUCTION PRACTICES

Current construction practices are summarized in Figs. 5 to 9.

5.1 Stud Information (Figs. 5 and 6)

Stud size: For all applications, almost the whole spectrum of stud sizes is used, but taking the average for the various applications, 25% indicated as a first choice the 92mm, 20ga. stud, 22% the 152mm, 20ga. stud and 22% the 152mm, 18ga. stud.

Heavier studs are generally used for commercial and high rise applications, while lighter studs are chosen for low rise residential buildings.

Stud spacing: The most commonly used stud spacing is 400mm, chosen by 71% of the respondents while 19% say they use a 600mm spacing and only 8% use a 300mm spacing.

Several respondents indicated that they will generally reduce the stud spacing for storey heights greater than 2.4m and one respondent mentioned that he will double up on studs with a spacing of 400mm or even 300mm for floor heights in excess of 3.0m.

Stud corrosion protection: 97% of respondents use galvanized studs while 3% use other means. None of them use paint.

Studs around window openings: 82% specify double studs on each side of window openings, 14% use single studs and 4% use other details.

Place of fabrication: 95% of the BV/SS walls are stick-built on site.

Method of assembly of wall panels: The most commonly used fastening method is screw fastening (74%), followed by a combination of welding and screw assemblage (20%). Welding alone is used by only 6% of the respondents.

Stud/ceiling track connection: 68% permit movement, 25% use fixed connections, 7% leave it up to the contractor. A slightly higher percentage of sliding connections are used in high rise buildings.

Top and bottom track attachment: Power actuated fasteners are favored at 70% while embedded anchor bolts, self

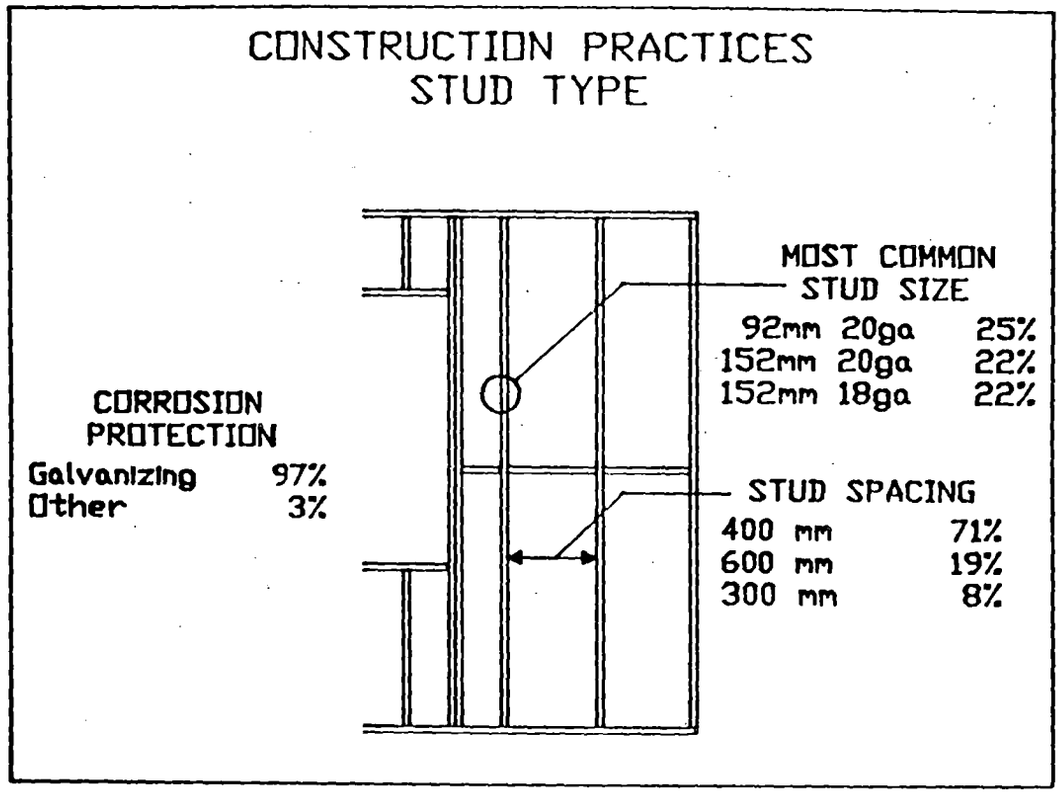


Fig. 5 Information on stud size, stud spacing and stud corrosion protection

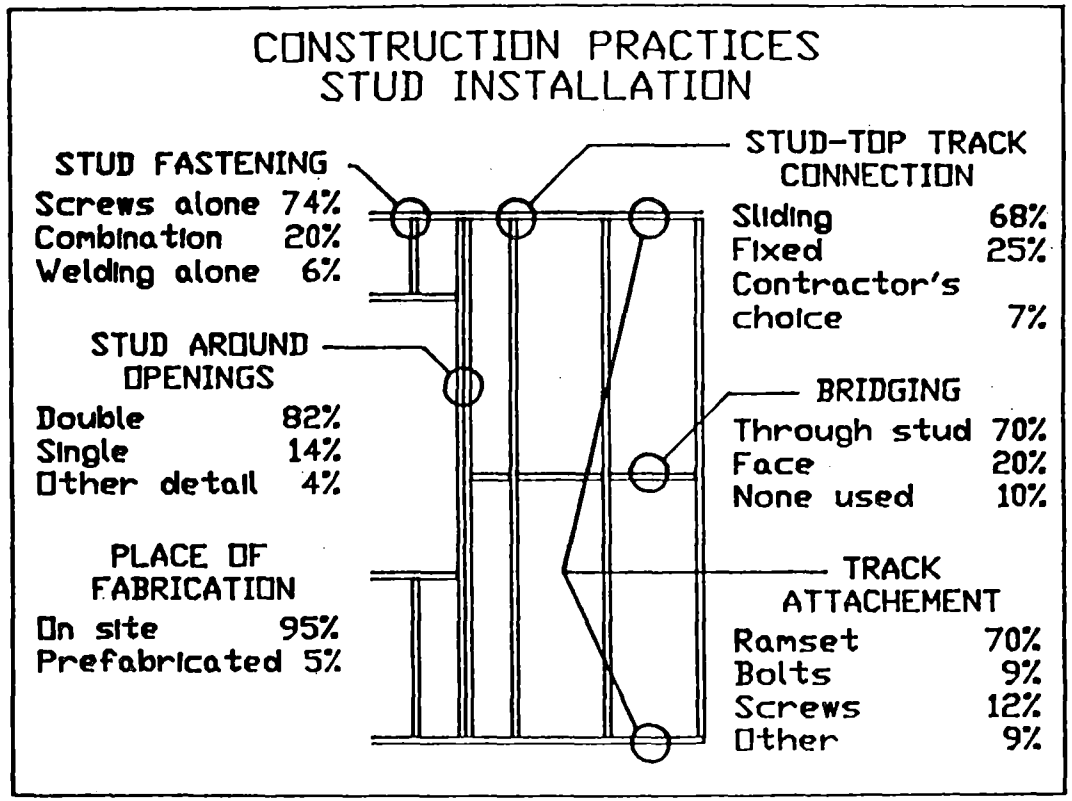


Fig. 6 Information on stud installation details

tapping screws and other devices share the remaining percentages approximately equally.

Type of steel bridging: Bridging through the knockout is used by 70% of the respondents, 20% use face bridging and 10% don't use bridging at all.

5.2 Brick Ties (Fig. 7)

Adjustable ties, screwed to the studs are used by 50% of the respondents, 28% use adjustable ties directly engaged with the studs, and 22% of the respondents use corrugated strip ties.

A good number of designers feel that strip ties should not be used as they may buckle in wider wall cavities.

Galvanizing is the most popular type (90%) of corrosion protection for brick ties.

5.3 Sheathing and Insulation (Fig. 8)

Inner sheathing: Little difference exists between low rise and high rise buildings as far as inner sheathing is concerned. 47% of the respondents indicated that they specify drywall only and about 46% use both drywall and insulation. For buildings less than four storeys, 5% will use insulation alone.

Outer sheathing: Again little difference exists between high and low rise buildings. 36% use drywall only, 36% use drywall and insulation and 22% use rigid or semi-rigid insulation alone.

Insulation: Two thirds use fiber batt insulation inside the wall cavity while one third use rigid insulation outside the stud wall.

5.4 Other Details (Fig. 9)

Caulking at Tracks: While 80% specify or apply caulking at the top and bottom tracks, it was pointed out that during cold weather installation caulking frequently hardens before the track can be installed. Under these circumstances, it is frequently difficult to ensure an air tight seal. For this reason, some contractors in the Ottawa area use a foam strip gasket and caulking at the top

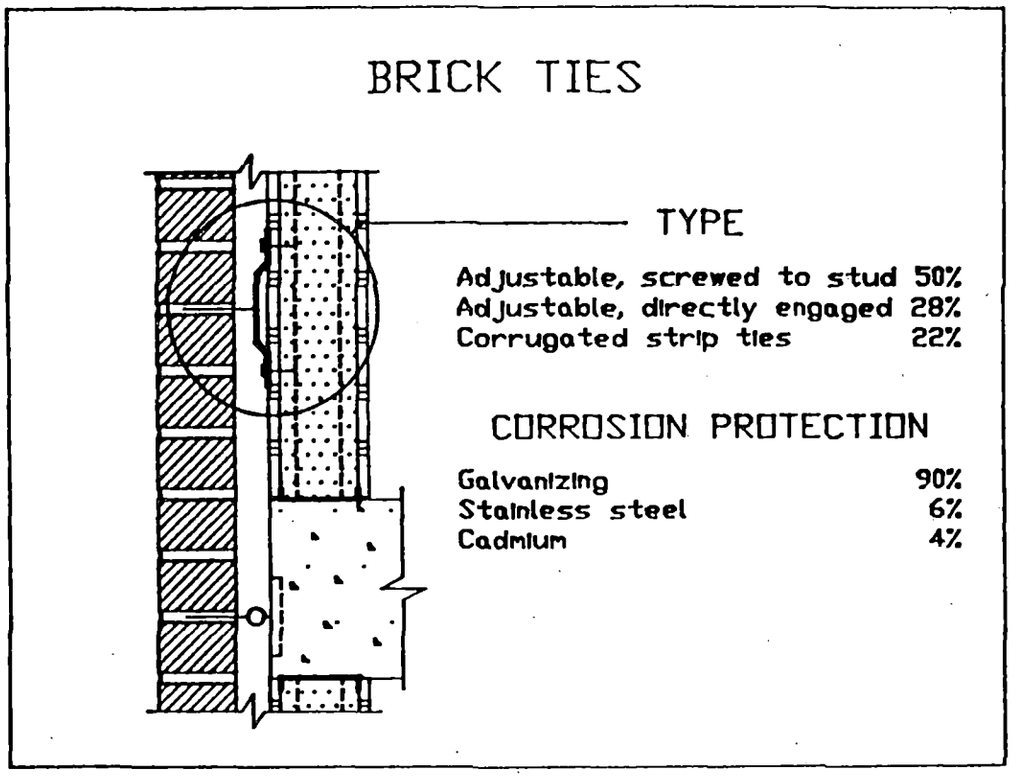


Fig. 7 Information on brick ties and corrosion protection

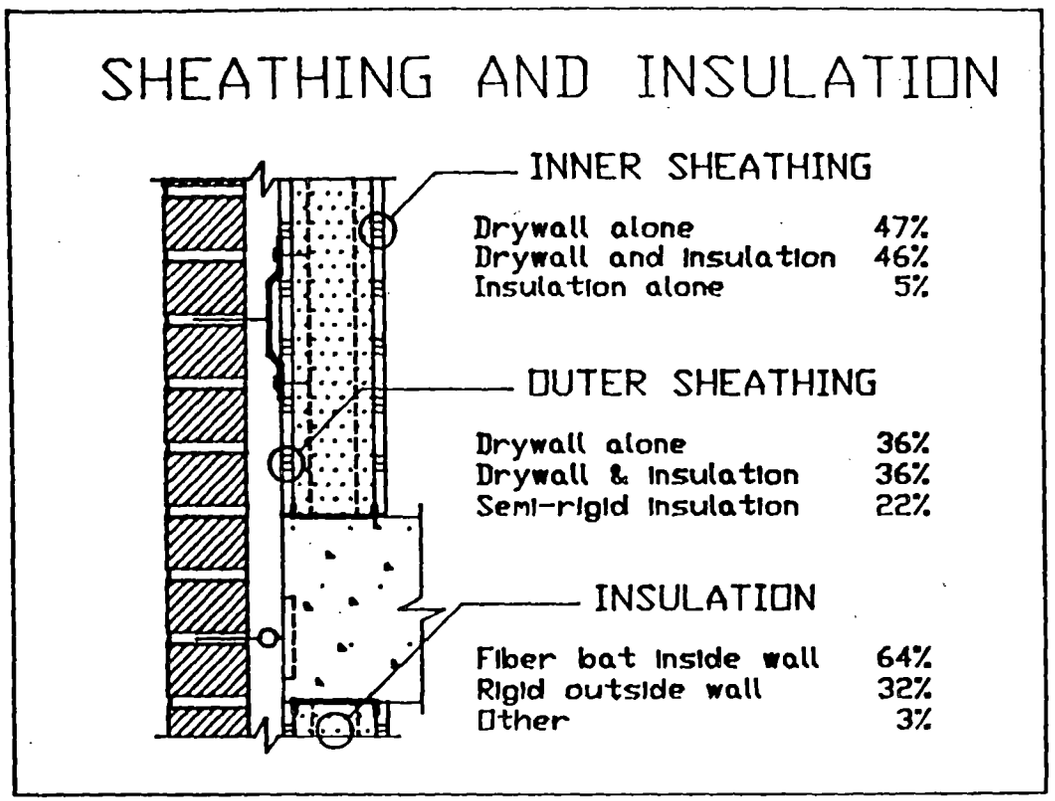


Fig. 8 Information on sheathing and insulation materials

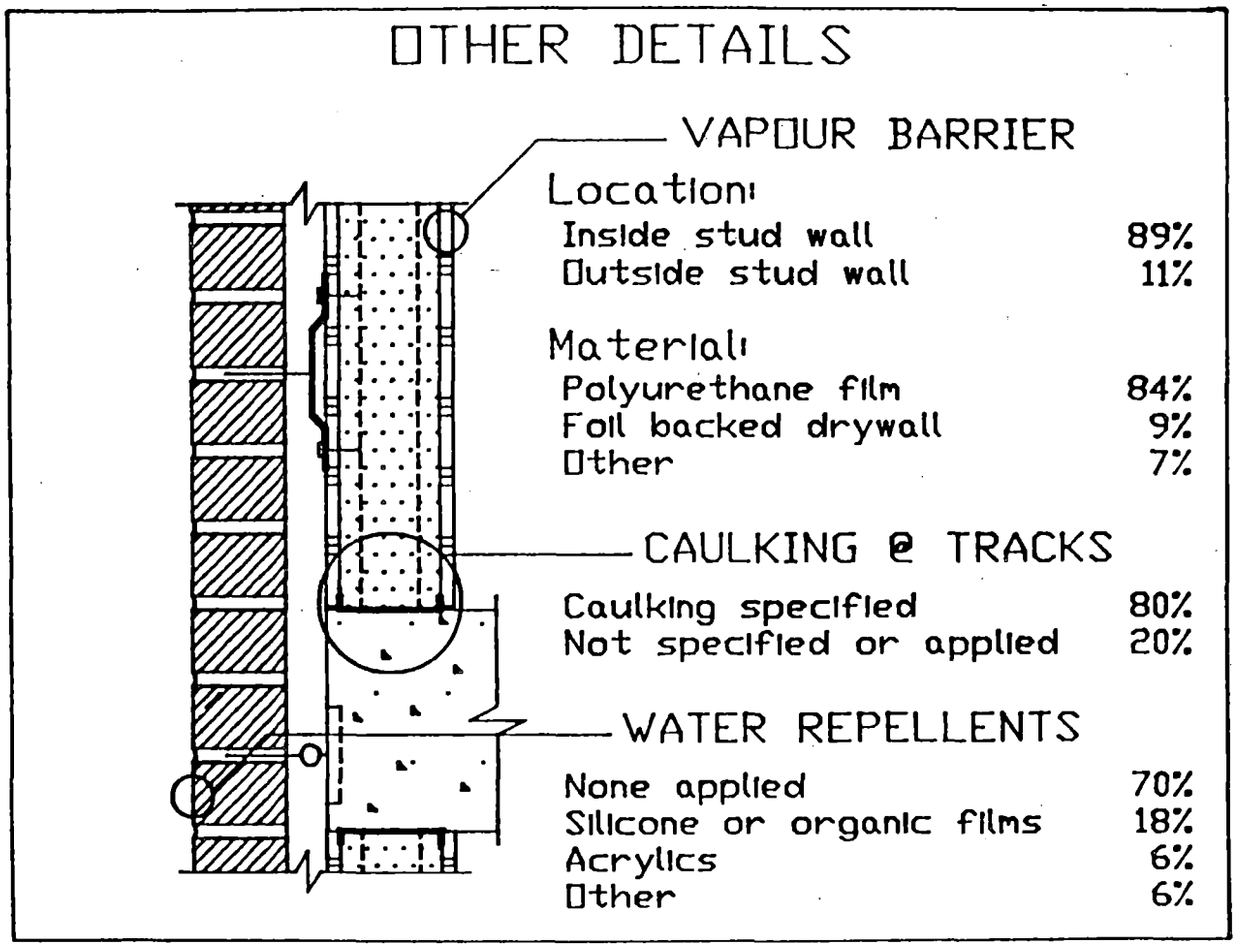


Fig. 9 Information on vapour barrier, track caulking and water repellents for masonry veneer

and bottom track/slab interface as well as perimeter caulking to ensure air tightness.

Vapour barrier: 89% of the time, the vapour barrier is specified inside the stud wall rather than outside. Polyurethane film is the most popular vapour barrier material (84%). Foil-backed drywall is used in about 9% of cases.

Water repellent treatment for brick veneer: Most respondents indicated that generally no special water repellent treatment is applied. If water repellent treatment is used at all, silicone is the most popular coating.

6.0 DETAILING

Contractors commented that professionals are often not willing or able to provide the necessary technical information.

This feeling is strongly supported by the survey, as illustrated in Fig. 10, where about 80% of steel stud/drywall contractors say they usually don't get a clear description of steel stud wall details with the tender drawings. They also reported frequent discrepancies between structural and architectural detail drawings for BV/SS walls.

7.0 BREAKDOWN OF WORK BETWEEN TRADES

The response to the question on how well the breakdown of work between trades is defined is illustrated in Fig. 11. While 60% of the steel stud/drywall contractors feel the breakdown of work between them and the masonry contractor is not very well defined, only 40% of the masonry contractors surveyed feel that way.

Since the survey indicates that steel stud/drywall and masonry contractors are most often responsible for constructing and installing the components of the BV/SS walls, future training efforts should be directed towards these two trades.

8.0 INSPECTION

All groups widely perceive inspection to be particularly important for this type of construction. The current level

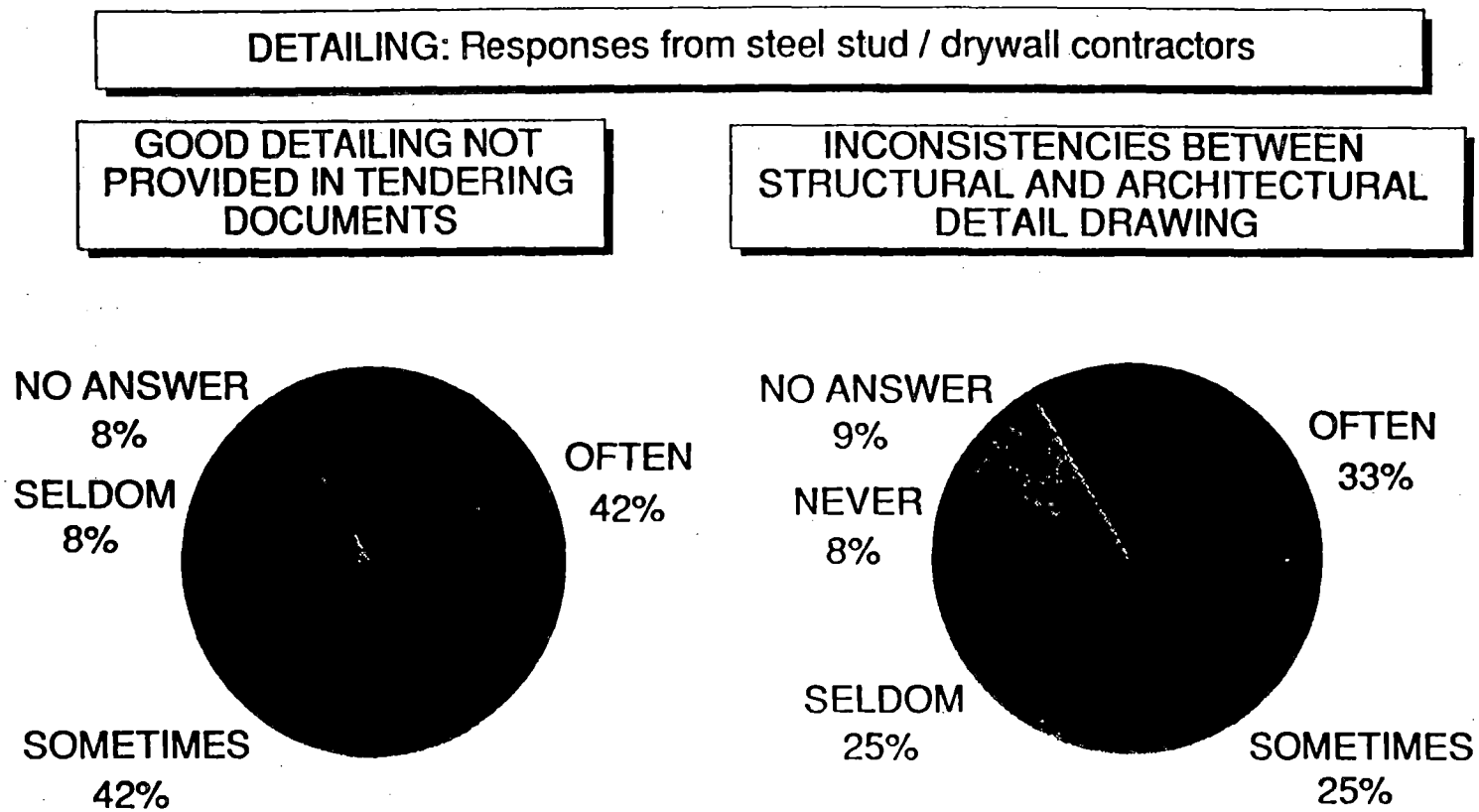


Fig. 10 Contractors responses to questions on detailing

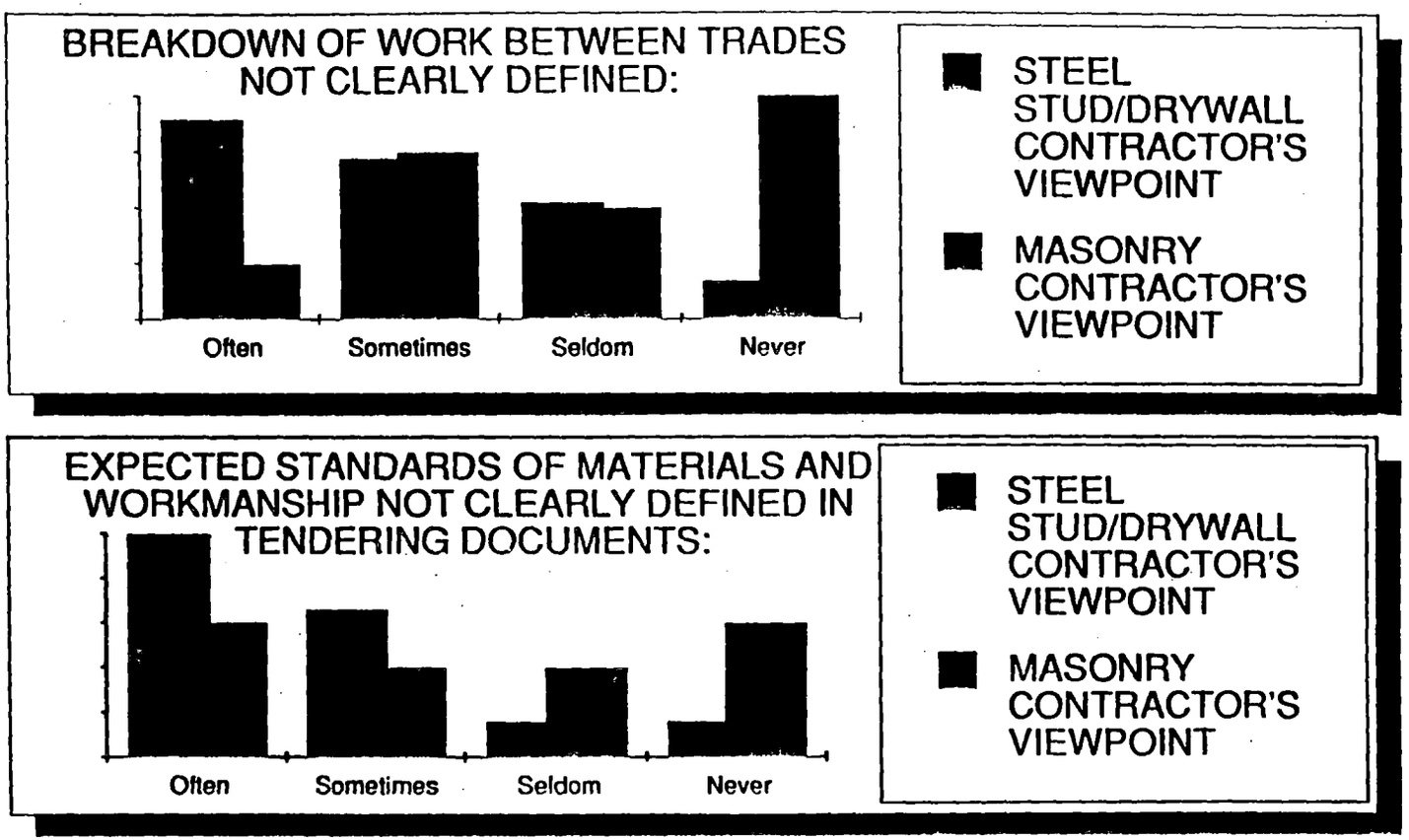


Fig. 11 Contractors responses to questions on work breakdown and expected standards of materials and workmanship

and quality of inspection is thought to be inadequate. As seen in Fig. 12, the survey showed that although inspection is usually performed, in 50% of the cases it is performed at completion of steel stud construction, sheathing and insulation or at a later stage.

This means that the steel stud structural integrity frequently cannot be verified.

9.0 PROBLEMS DURING CONSTRUCTION

Professionals were asked to list the most common problems encountered with the system during construction and one third of the respondents indicated workmanship, inexperienced tradesmen or non-compliance with specifications to be a major problem. This points to the urgency for more education and technology transfer.

While few respondents have reported corrosion of metal components to be a problem at the present time, a good number have shown great concern about the long term performance of the system because of the risk of corrosion. The most common construction problems encountered by professionals are summarized in Table 3.

Table 3 Most Common Problems Encountered by Professionals with the Construction of BV/SS Walls

PROBLEMS	PERCENTAGE
Poor workmanship, inexperienced tradesmen, wrong trade, non-compliance with specifications.....	31
Poor waterproofing and corrosion protection, discontinuity of air/vapour barrier and insulation.....	20
Inadequate brick ties or brick tie connections.....	16
Inadequate stud thickness and framing for openings (services and windows), inadequate bridging.....	9
Improper stud connections and anchoring.....	7
Excessive stud deflection due to wind load.....	2
Other (moisture penetration, cold bridging, poor stud assembly).....	15

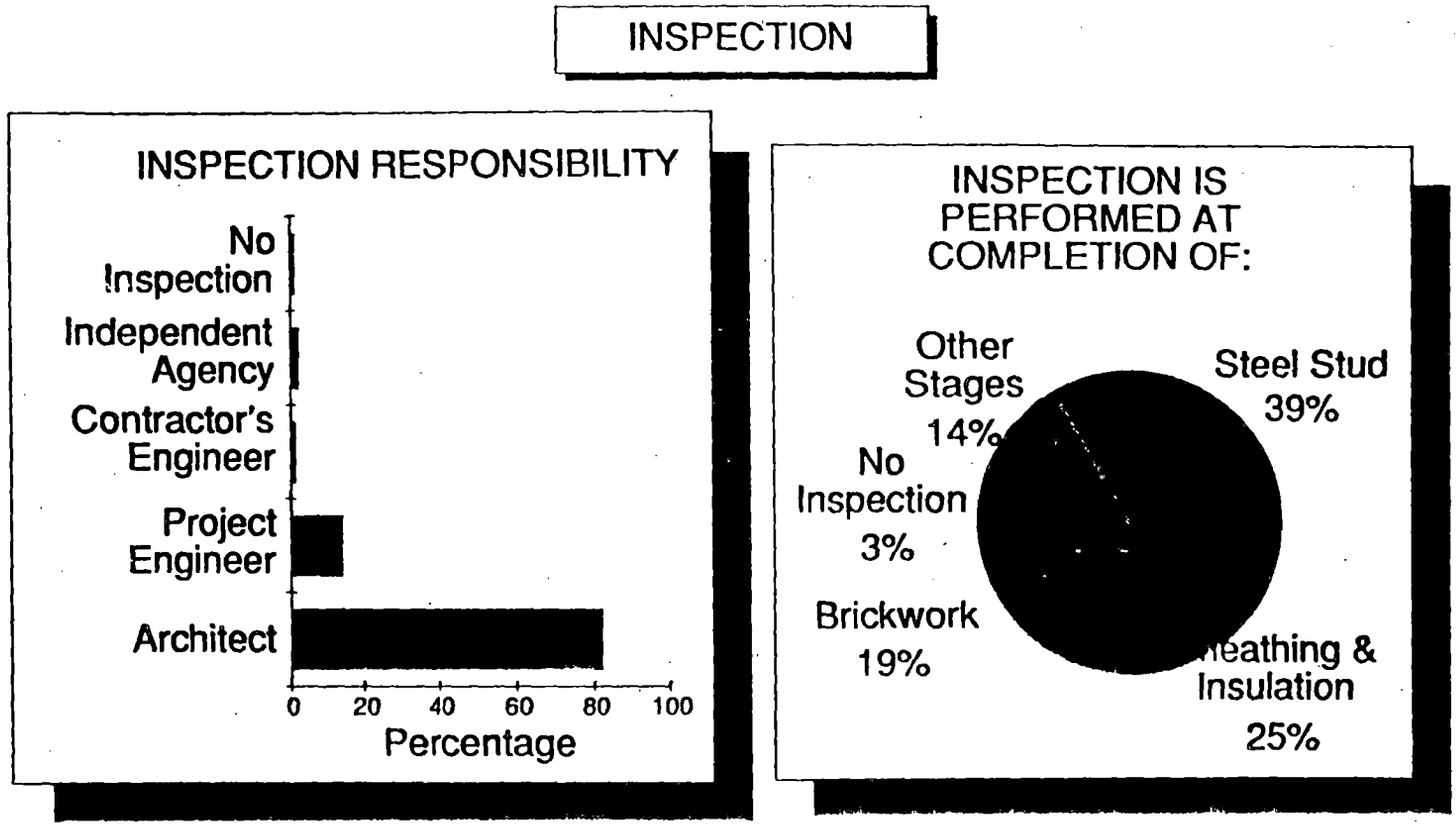


Fig. 12 Inspection requirements and responsibilty

10.0 INFORMATION AND RESEARCH NEEDS

Upon reviewing the comments in each questionnaire, it emerges that most respondents, regardless of their group, feel that the level of knowledge and understanding or expertise in the field of brick veneer/steel stud construction is inadequate. A very high percentage have expressed the need for standardization, and some consider this to be an urgent requirement. The responses to these questions are illustrated in Fig. 13.

All groups seem to perceive the BV/SS wall system as sensitive both to design and construction. Compared to the masonry backup system, it is thought of as being less forgiving to error at either level of implementation.

Professionals have also often expressed their own need for more information on the behaviour and strength of the BV/SS wall system, frequently pointing at particular areas they felt they should know more about. Items most frequently mentioned are:

- brick ties - type
  - strength
  - spacing
- longterm performance of the wall system
- corrosion of metal components
- maximum deflection criteria
- detailing - stud/track connection
  - bridging

In general, it appears that professionals are seeking improvements in the level of technological knowledge as well as the transfer of such knowledge to contractors.

11.0 GENERAL COMMENTS

The questionnaire also solicited general comments and opinions from respondents on the BV/SS wall system.

The key comments received from professionals address problems in the field and the question of professional fees. Pertaining to problems in the field, professionals mentioned primarily workmanship, inexperienced tradesmen and non-compliance with specifications as the key problems. But professionals also pointed out that fees do not usually include design and inspection of the BV/SS wall system.

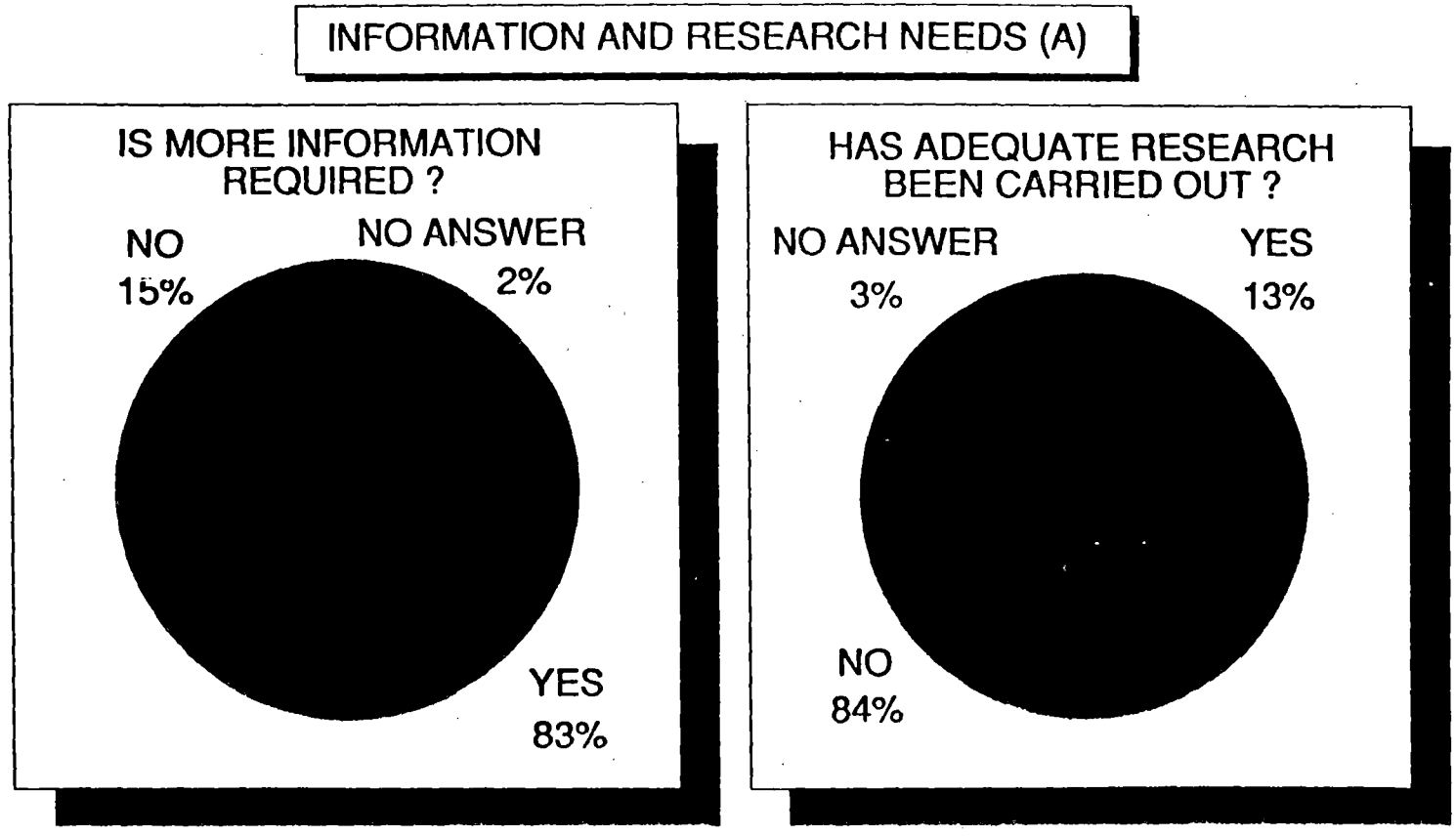


Fig. 13 Information and research requirements

The following comments were received by contractors:

- The successful performance of the BV/SS wall system depends on proper installation and inspection.
- Details are frequently not clearly defined.
- Generally, better professional support is required. Professionals are often not willing to provide required technical information.
- Architects and Engineers often refuse to accept responsibility for the design of the BV/SS wall system, leaving it up to contractors to choose materials and member sizes.

12.0 SUMMARY

The main purpose of this survey was to identify and establish the state of industry concern for the BV/SS wall system in Canada. The small number of responses received in some regions of the country and the location of the respondents in these regions make the case of regional analysis an impractical task. However, the findings from the four surveys can be summarized under the following six headings.

12.1 Uses of the BV/SS Wall System Across the Country

The BV/SS wall system is used across Canada both in residential and commercial buildings. The buildings' structural system typically, consists of steel framing, concrete framing or loadbearing steel stud walls. The BV/SS wall system is more popular in buildings less than four storeys tall. The number of years that this system has been in use varies across the country from a low of 6.5 years in Pacific Canada to a high of 9.5 years in the Prairie Region and Northern Ontario. The Nation's average use of the BV/SS wall system is approximately 8 years.

12.2 BV/SS Wall Design

The project architect is most often the designer and inspector of BV/SS walls during construction. No standardized procedures for inspection during construction exist. The design is based on product catalogues and related industry publications.

Regarding stud spacing, the 400 mm o.c. steel stud spacing is the most popular choice. In buildings less than 4 storeys tall, the 92 mm C-stud is most frequently used. In taller buildings, the 152 mm C-stud is used most often. The use of the double stud as a vertical trimmer around window openings is common practice. Galvanizing was found to be the most popular type of corrosion protection for steel studs and brick ties.

Inner sheathing materials most often consist of either drywall only or insulation and drywall. Outer sheathing materials are most often made up of drywall and insulation. Fibre batts within the stud space are the most common insulation material in use. The application of caulking between building slabs and top and/or bottom tracks is common practice.

The most popular vapour barrier consists of plastic film (poly) and it is generally applied on the inside face of the steel studs. Adjustable ties, screwed directly to the studs are the most popular means of securing the brick veneer. The maximum lateral stud deflection limit is specified most frequently as L/360.

12.3 BV/SS Wall Construction

BV/SS walls are most often stick-built on the job site using screw fasteners. A connection permitting slab movement is commonly used between studs and ceiling tracks. The use of power activated fasteners to attach bottom and top tracks is common practice and the bracing of steel studs is most often done through the steel stud knockouts. Since the steel stud/drywall contractors and the masonry contractors are most often involved in the installation of the BV/SS wall system, future education and technology transfer efforts should be directed primarily towards these two trades.

12.4 In-Service Problems

The majority of respondents had encountered BV/SS walls which were not performing satisfactorily. The most common deficiency appears to be air infiltration. Improved detailing and installation practices on air barriers are required. Corrosion of metal components such as studs, screws and ties as well as excessive stud flexibility have not generally been observed as major problems.

12.5 Additional Research and Technology Transfer Requirements

The need for more information and research is recognized by all respondents. The most common problems related to design and construction of BV/SS walls could be reduced with a better transfer of existing and future technology, and with additional training.

12.6 Recommendations

The key recommendations offered by the respondents are as follows:

- conduct more research on:
  - longterm performance of the BV/SS wall system
  - deflection/stiffness characteristics
  - strength of ties
- prohibit the use of strip ties and screwed-on ties
- produce good standards and design aids
- improve level of inspection
- encourage that design is performed by professionals who are competent on the subject.

12.7 Conclusions

The survey showed clearly that the system has a large percentage of supporters but that there is considerable concern over it's safety in the long term. Approximately 10 - 20% say they would not use the system at this time.

Both builders and consultants widely expressed their need for more information on the topic. Contractors stressed their need for better professional support while architects and engineers expressed their need for more technical information.

The great majority would like more research to be conducted on the BV/SS wall system. It appears that the publication of an official standard would be welcomed by many respondents.

APPENDIX A: Sample Questionnaires

A

GROUP A

SURVEY OF STEEL STUD/BRICK VENEER DESIGN AND CONSTRUCTION PRACTICES IN CANADA

CONTENT

I. Experience with Steel Stud/Brick Veneer Construction

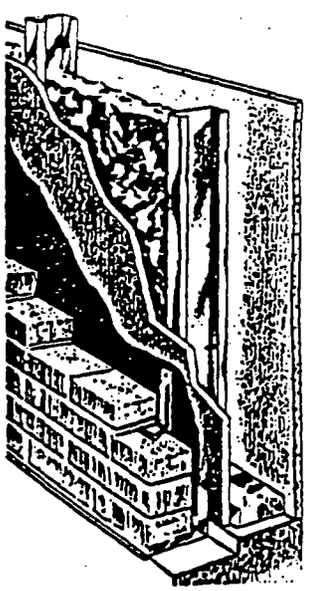
II. Details of New Steel Stud/Brick Veneer Construction

III. Responsibility for New Construction

IV. In-Service Problems

This questionnaire forms part of a CMHC study of masonry veneer walls supported by steel studs. Advisory Documents directed to the design and construction industries will include results of this survey of current practice.

You need not identify yourself to complete the questionnaire. However, if you wish to receive a copy of the Advisory Documents, please indicate your name and business address below, or attach your card. A copy will be sent to you as soon as the Advisory Documents are released.



Please return this questionnaire within two weeks to:

Mr. Robert Duncan P.Eng.
Canada Mortgage and Housing Corporation
2nd Floor Annex
National Office
682 Montreal Road
Ottawa, Ontario K1A 0P7

SURVEY OF STEEL STUD/BRICK VENEER DESIGN AND CONSTRUCTION PRACTICES IN CANADA

I. EXPERIENCE WITH STEEL STUD/BRICK VENEER CONSTRUCTION

1. What type of business are you in?

   Building Authority..... ☐
   Structural Engineering..... ☐
   Architectural Design..... ☐
   Masonry Contracting..... ☐
   Steel Stud Contracting..... ☐
   Independent Inspection Agency..... ☐
   Other (please specify)_____ ☐

2. Where do you conduct the bulk of your business?

   Atlantic Canada..... ☐
   Southern Quebec/Southern Ontario..... ☐
   Prairie Region/Northern Ontario..... ☐
   Pacific Canada..... ☐
   Other (please specify) _____ ☐

3. How long have you been involved with wind-bearing steel stud/brick veneer walls?

   _____ years

   If you have not encountered this system, it is not necessary to complete the questionnaire, but please return it. Thank you.

4. Approximately how many buildings using steel stud/brick veneer exterior walls have you handled? Please provide the number of buildings which fit each of the descriptions given below. Note, some buildings may fit more than one description.

   4.1 Total number of steel stud/brick veneer buildings _____

   Of these, approximately how many had

   4.2 Structural steel frames?..... —
   4.3 Structural concrete frames?..... —
   4.4 Gravity load-bearing steel stud walls?..... —

   Approximately how many are

   4.5 Residential buildings?..... —
   4.6 Commercial, office, or industrial space?..... —
   4.7 Less than four storeys tall?..... —
   4.8 Four storeys or taller?..... —

   4.9 How long have buildings with steel stud/brick veneer been built in your area?

   _____ years

II. DETAILS OF NEW STEEL STUD/BRICK VENEER CONSTRUCTION

Table 1 Common Steel Studs

Code	Stud Description
1	(3 5/8") 92mm C-Stud 0.74 mm (22ga)
2	92mm C-Stud 0.85 mm
3	92mm C-Stud 0.91 mm (20ga)
4	92mm C-Stud 1.2 mm (18ga)
5	92mm 1.5 mm (16ga)
6	(6") 152mm C-Stud 0.74 mm (22ga)
7	152mm C-Stud 0.85 mm
8	152mm C-Stud 0.91 mm (20ga)
9	152mm C-Stud 1.2 mm (18ga)
10	152mm C-Stud 1.5 mm (16ga)
11	Other (please specify)

5. Please indicate your current first and second choice stud selection for each building type, using the codes provided in Table 1.

		First Choice	Second Choice
5.1	Low rise residential buildings?	.....	.....
5.2	Low rise commercial buildings?	.....	.....
5.3	Residential buildings four storeys or taller?	.....	.....
5.4	Commercial buildings four storeys or taller?	.....	.....

6. What stud <u>spacing</u> is most common?

12" (300 mm) o.c. ..... ☐
16" (400 mm) o.c. ..... ☐
24" (600 mm) o.c. ..... ☐
Other (please specify) _____ ☐

7. What is the most common vertical trimmer each side of window openings on your projects?

Single studs..... ☐
Double studs..... ☐
Other (please specify) _____ ☐

8. What is the typical corrosion protection for steel studs on your current projects?

Paint..... ☐
Galvanizing..... ☐
Other (please specify)_____ ☐

_____

9. Do you use your own standard steel stud/brick veneer wall sections? If so, please provide a copy of each such section, identifying the type of building it is used in.

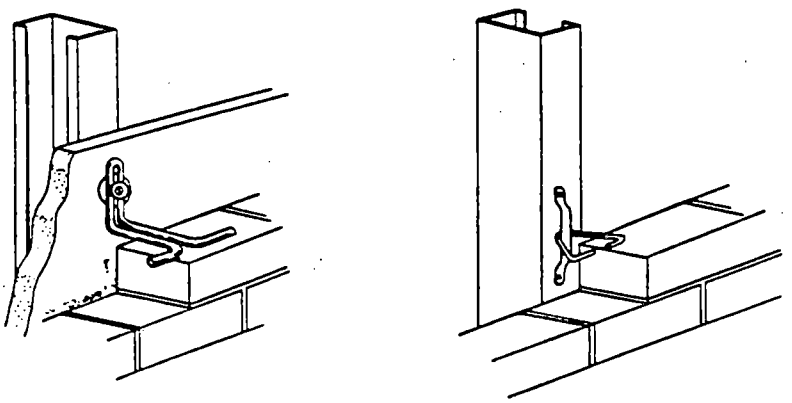
10. What do you most frequently specify as :	Buildings less than 4 storeys (check one)	Buildings 4 storeys or taller (check one)
10.1 Stud wall inner sheathing?		
Drywall only.....	.....	.....
Insulation only.....	.....	.....
Drywall and Insulation.....	.....	.....
Other (please specify)_____	.....	.....
10.2 Stud wall outer sheathing?		
Drywall only.....	.....	.....
Rigid or Semi-Rigid Insulation only	.....	.....
Drywall and Insulation.....	.....	.....
Other (please specify)_____	.....	.....
10.3 Wall panel assembly location?		
Factory pre-built.....	.....	.....
Stick-built on site.....	.....	.....
10.4 Wall panel assembly method?		
Welding.....	.....	.....
Screw fasteners.....	.....	.....
Combined welding and screws.....	.....	.....
10.5 Connection between studs and ceiling track ?		
Fixed stud-track connections.....	.....	.....
Connections permitting slab movement	.....	.....
Contractor's choice of connection..	.....	.....
10.6 Top and bottom track attachment to building?		
Power actuated fasteners.....	.....	.....
Embedded anchor bolts.....	.....	.....
Self tapping screws.....	.....	.....
Other (please specify)_____	.....	.....
10.7 Steel bridging between studs?		
Bridging through the knockout.....	.....	.....
Face bridging.....	.....	.....
Nothing.....	.....	.....

	Buildings less than 4 storeys (check one)	Buildings 4 storeys or taller (check one)
10.8 Insulation?		
No insulation	.....	.....
Rigid insulation outside stud wall	.....	.....
Fibre batts within the stud space	.....	.....
Other insulation (please specify)		
What? _____	.....	.....
Where? _____	.....	.....
10.9 Caulking location?		
Caulking between building and top and/or bottom tracks	.....	.....
Not specified	.....	.....
10.10 Vapour barrier location?		
Inside stud wall	.....	.....
Outside stud wall	.....	.....
None	.....	.....
10.11 Vapour barrier material?		
Building paper	.....	.....
Plastic film (poly)	.....	.....
Foil-backed drywall	.....	.....
Foil-backed insulation	.....	.....
None	.....	.....
Other (please specify) _____	.....	.....
10.12 Exterior water repellent treatment for brick veneer?		
None	.....	.....
Silicone or organic coatings	.....	.....
Silanes or siloxanes	.....	.....
Acrylic water repellents	.....	.....
Other (please specify) _____	.....	.....

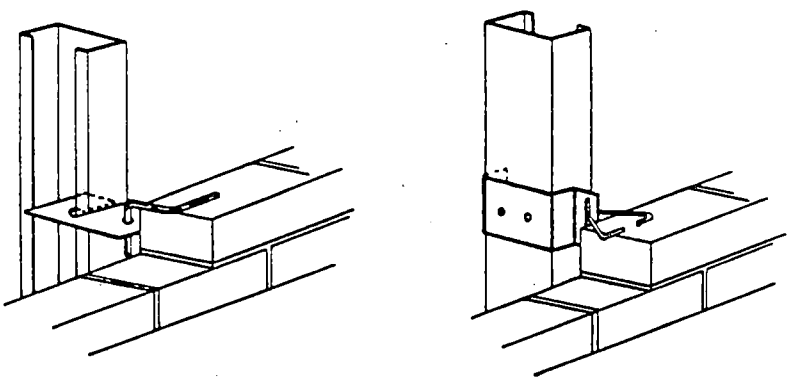
	In all buildings (check one)
10.13 Brick tie?	
Corrugated strip ties	.....
Adjustable tie, screwed to stud	.....
Adjustable tie, directly engaged with stud	.....
Other (please specify) _____	.....

Note, typical brick ties shown on next page.

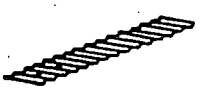
10.14 Brick tie corrosion protection?	
Galvanizing	.....
Cadmium plating	.....
Stainless steel	.....
Nothing	.....



Adjustable tie, screwed-on to stud



Adjustable tie, directly engaged to stud



Corrugated strip tie

III. RESPONSIBILITY FOR NEW CONSTRUCTION

11. Which party most frequently <u>designs</u> steel stud/brick veneer walls.

- Project architect..... ☐
- Project structural engineer..... ☐
- Sub-contractor's structural engineer..... ☐
- Other (please specify)_____ ☐

12. Which party most frequently <u>reviews/inspects</u> steel stud/brick veneer walls under construction?

- Project architect ..... ☐
- Project structural engineer ..... ☐
- Sub-contractor's structural engineer..... ☐
- Independent inspection agency..... ☐
- No inspection performed..... ☐
- Other (please specify)_____ ☐

13. In your experience, at what stage of completion are steel stud/brick veneer walls inspected?

- At completion of steel stud wall assembly..... ☐
- At completion of steel stud sheathing and insulating..... ☐
- At completion of brickwork..... ☐
- No inspection performed..... ☐
- Other (please specify)_____ ☐

14. What maximum lateral steel stud deflection do you permit under design wind load?

- $\frac{L}{240}$ or greater..... ☐
- $\frac{L}{360}$ ..... ☐
- $\frac{L}{600}$ ..... ☐
- $\frac{L}{720}$ ..... ☐
- Other (please specify)_____ ☐

"L" is the height of a simply supported steel stud.

15. Are shop drawings of steel stud/brick veneer walls required by the project specifications?

	Buildings less than 4 storeys (check one)	Buildings 4 storeys or taller (check one)
Always.....	.....	.....
Often.....	.....	.....
Sometimes.....	.....	.....
Seldom.....	.....	.....
Never.....	.....	.....

16. Please indicate with a (✓) in each row, which trade is most often responsible for installing the following items?

	Item \ Trade	Drywall	Masonry	Carpentry	Steel	Other
16.1	Steel studs					
16.2	Interior insulation (within studs)					
16.3	Exterior insulation					
16.4	Interior vapour barrier					
16.5	Exterior moisture barrier					
16.6	Flashing					
16.7	Top and bottom track caulking					
16.8	Other caulking at shelf angles, windows					

17. Do you feel that you need more information on the steel stud/brick veneer system:

Yes..... ☐ No..... ☐

If yes, what kind of information would be most useful?

18. Do you feel that adequate research has been carried out on the steel stud/brick veneer system?

Yes..... ☐ No..... ☐

19. What standards or guidelines do you currently use?

.....

.....

.....

20. Please list the most common problems you have encountered with the system during construction.

.....

.....

.....

IV. IN-SERVICE PROBLEMS

21. Have you ever investigated a steel stud/brick veneer wall which was not performing satisfactorily?

Yes..... ☐ No..... ☐

If yes, please answer the following questions.
If no, thank you for completing this questionnaire.

Please check (✓) how often you have seen the following problems on steel stud/brick veneer structures.

	Type of Problem	Never	Seldom	Sometimes	Often
21.1	Brick spalling.....	.....	.....	.....	.....
21.2	Mortar crushing.....	.....	.....	.....	.....
21.3	Vertical masonry cracking.	.....	.....	.....	.....
21.4	Masonry wall buckling.....	.....	.....	.....	.....
21.5	Drywall cracking.....	.....	.....	.....	.....
21.6	Moisture penetration.....	.....	.....	.....	.....
21.7	Efflorescence on masonry..	.....	.....	.....	.....
21.8	Poor door and window mounting.....	.....	.....	.....	.....
21.9	Flashing related problems.	.....	.....	.....	.....
21.10	Absence/plugged weepholes.	.....	.....	.....	.....
21.11	Loose shelf angles.....	.....	.....	.....	.....
21.12	Corroded shelf angles.....	.....	.....	.....	.....
21.13	Corroded studs.....	.....	.....	.....	.....
21.14	Corroded ties.....	.....	.....	.....	.....
21.15	Corroded screws.....	.....	.....	.....	.....
21.16	Discontinuous air/vapour barrier.....	.....	.....	.....	.....
21.17	Excessive mortar in wall cavity.....	.....	.....	.....	.....
21.18	Wet insulation and drywall	.....	.....	.....	.....
21.19	Air infiltration.....	.....	.....	.....	.....
21.20	Cold bridging.....	.....	.....	.....	.....
21.21	Water infiltration.....	.....	.....	.....	.....
21.22	Leakage at stud tracks....	.....	.....	.....	.....
21.23	Other (please specify)....	.....	.....	.....	.....

22. Please use the space below for any comments or opinions you have on the steel stud/brick veneer exterior wall system.

.....

.....

.....

GROUP B

SURVEY OF STEEL STUD/BRICK VENEER DESIGN AND CONSTRUCTION PRACTICES IN CANADA

CONTENT

I. Experience with Steel Stud/Brick Veneer Construction

II. Details of New Steel Stud/Brick Veneer Construction

III. Responsibility for New Construction

This questionnaire forms part of a CMHC study of masonry veneer walls supported by steel studs. Advisory Documents, directed to the design and construction industries, will include results of this survey of current practice.

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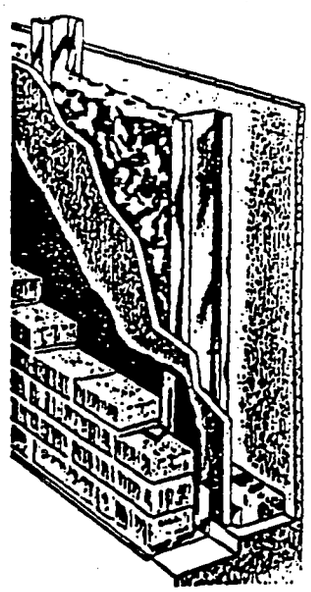

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SURVEY OF
STEEL STUD/BRICK VENEER
DESIGN AND CONSTRUCTION PRACTICES
IN CANADA

I. EXPERIENCE WITH STEEL STUD/BRICK VENEER CONSTRUCTION

1. What type of business are you in?

   Building Authority..... ☐
   Structural Engineering..... ☐
   Architectural Design..... ☐
   Masonry Contracting..... ☐
   Steel Stud Contracting..... ☐
   Independent Inspection Agency..... ☐
   Other (please specify) _____ ☐

2. Where do you conduct the bulk of your business?

   Atlantic Canada..... ☐
   Southern Quebec/Southern Ontario..... ☐
   Prairie Region/Northern Ontario..... ☐
   Pacific Canada..... ☐
   Other (please specify) _____ ☐

3. How long have you been involved with wind-bearing steel stud/brick veneer walls?

   _____ years

   If you have not encountered this system, it is not necessary to complete the questionnaire, but please return it. Thank you.

4. Approximately how many buildings using steel stud/brick veneer exterior walls have you handled? Please provide the number of buildings which fit each of the descriptions given below. Note, some buildings may fit more than one description.

   4.1 Total number of steel stud/brick veneer buildings _____

   Of these, approximately how many had

   4.2 Structural steel frames?..... —
   4.3 Structural concrete frames?..... —
   4.4 Gravity load-bearing steel stud walls?..... —

   Approximately how many are

   4.5 Residential buildings?..... —
   4.6 Commercial, office, or industrial space?..... —
   4.7 Less than four storeys tall?..... —
   4.8 Four storeys or taller?..... —

   4.9 How long have buildings with steel stud/brick veneer been built in your area?

   _____ years

II. DETAILS OF NEW STEEL STUD/BRICK VENEER CONSTRUCTION

5. What stud <u>spacing</u> is most common?

12" (300 mm) o.c. ..... ☐
16" (400 mm) o.c. ..... ☐
24" (600 mm) o.c. ..... ☐
Other (please specify) _____ ☐

6. What do you most frequently encounter as : (check one)

6.1 Exterior water repellent treatment for brick veneer?

None..... .....
Silicone or organic coatings..... .....
Silanes or siloxanes..... .....
Acrylic water repellents..... .....
Other (please specify) _____ .....

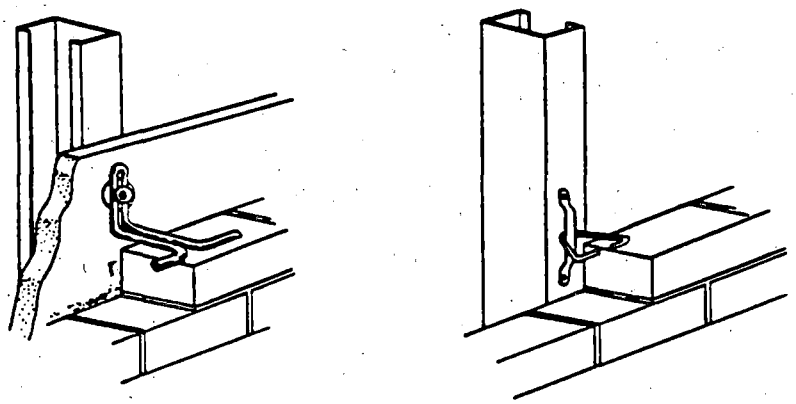
6.2 Brick tie?

Corrugated strip ties..... .....
Adjustable tie, screwed to stud..... .....
Adjustable tie, directly engaged with stud..... .....
Other (please specify) _____ .....

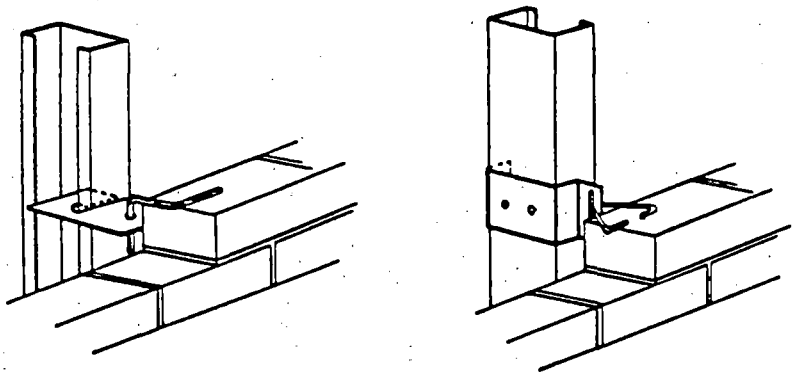
Note, typical brick ties shown on next page.

6.3 Brick tie corrosion protection?

Galvanizing..... .....
Cadmium plating..... .....
Stainless steel..... .....
Nothing..... .....



Adjustable tie, screwed-on to stud



Adjustable tie, directly engaged to stud

Corrugated strip tie

III. RESPONSIBILITY FOR NEW CONSTRUCTION

Please indicate with a (✓) the answer that best fits your business experience.

7. How often do you encounter the following situations during tendering and construction of steel stud/brick veneer structures?

Type of Problem	Often	Sometimes	Seldom	Never
7.1 The breakdown of work between the masonry subcontractor and the steel stud subcontractor is not clearly defined.....	.....	.....	.....	.....
7.2 Standards of material and workmanship expected in the steel stud/brick veneer wall are not clear during tendering	.....	.....	.....	.....

8. Which of the following professionals inspect steel stud/brick veneer walls under construction?

	Often	Sometimes	Seldom	Never
8.1 Project architect.....	.....	.....	.....	.....
8.2 Project structural engineer..	.....	.....	.....	.....
8.3 General contractor's inspector.....	.....	.....	.....	.....
8.4 Independent inspection agency.....	.....	.....	.....	.....

9. How often are steel stud/brick veneer walls inspected at each stage of construction?

	Often	Sometimes	Seldom	Never
9.1 At completion of steel stud wall assembly.....	.....	.....	.....	.....
9.2 At completion of steel stud sheathing and insulating.....	.....	.....	.....	.....
9.3 At completion of brickwork...	.....	.....	.....	.....
9.4 No inspection is performed...	.....	.....	.....	.....

10. Please indicate with a (✓) in each row, which trade is most often responsible for installing the following items?

	Item \ Trade	Drywall	Masonry	Carpentry	Steel	Other
10.1	Steel studs					
10.2	Interior insulation (within studs)					
10.3	Exterior insulation					
10.4	Interior vapour barrier					
10.5	Exterior moisture barrier					
10.6	Flashing					
10.7	Top and bottom track caulking					
10.8	Other caulking at shelf angles, windows					

13. Please use the space below for any comments or opinions you have on the steel stud/brick veneer exterior wall system.

.....

.....

.....

C

GROUP C

SURVEY OF STEEL STUD/BRICK VENEER DESIGN AND CONSTRUCTION PRACTICES IN CANADA

CONTENT

I. Experience with Steel Stud/Brick Veneer Construction

II. Details of New Steel Stud/Brick Veneer Construction

III. Responsibility for New Construction

This questionnaire forms part of a CMHC study of masonry veneer walls supported by steel studs. Advisory Documents, directed to the design and construction industries, will include results of this survey of current practice.

You need not identify yourself to complete the questionnaire. However, if you wish to receive a copy of the Advisory Documents, please indicate your name and business address below, or attach your card. A copy will be sent to you as soon as the Advisory Documents are released.

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SURVEY OF STEEL STUD/BRICK VENEER DESIGN AND CONSTRUCTION PRACTICES IN CANADA

I. EXPERIENCE WITH STEEL STUD/BRICK VENEER CONSTRUCTION

1. What type of business are you in?

- Building Authority..... ☐
- Structural Engineering..... ☐
- Architectural Design..... ☐
- Masonry Contracting..... ☐
- Steel Stud Contracting..... ☐
- Independent Inspection Agency..... ☐
- Other (please specify)_____ ☐

2. Where do you conduct the bulk of your business?

- Atlantic Canada..... ☐
- Southern Quebec/Southern Ontario..... ☐
- Prairie Region/Northern Ontario..... ☐
- Pacific Canada..... ☐
- Other (please specify)_____ ☐

3. How long have you been involved with wind-bearing steel stud/brick veneer walls?

_____ years

If you have not encountered this system, it is not necessary to complete the questionnaire, but please return it. Thank you.

4. Approximately how many buildings using steel stud/brick veneer exterior walls have you handled? Please provide the number of buildings which fit each of the descriptions given below. Note, some buildings may fit more than one description.

4.1 Total number of steel stud/brick veneer buildings _____

Of these, approximately how many had

4.2 Structural steel frames?..... —
4.3 Structural concrete frames?..... —
4.4 Gravity load-bearing steel stud walls?..... —

Approximately how many are

4.5 Residential buildings?..... —
4.6 Commercial, office, or industrial space?..... —
4.7 Less than four storeys tall?..... —
4.8 Four storeys or taller?..... —

4.9 How long have buildings with steel stud/brick veneer been built in your area?

_____ years

II. DETAILS OF NEW STEEL STUD/BRICK VENEER CONSTRUCTION

5. What stud spacing is most common?

12" (300 mm) o.c. ..... ☐
16" (400 mm) o.c. ..... ☐
24" (600 mm) o.c. ..... ☐
Other (please specify)_____ ☐

6. What is the most common vertical trimmer each side of window openings on your projects?

Single studs..... ☐
Double studs..... ☐
Other (please specify)_____ ☐

7. What is the typical corrosion protection for steel studs on your current projects?

Paint..... ☐
Galvanizing..... ☐
Other (please specify)_____ ☐

8. What do you most frequently install as :	Buildings less than 4 storeys (check one)	Buildings 4 storeys or taller (check one)
8.1 Stud wall inner sheathing?		
Drywall only.....	.....	.....
Insulation only.....	.....	.....
Drywall and Insulation.....	.....	.....
Other (please specify)_____	.....	.....
8.2 Stud wall outer sheathing?		
Drywall only.....	.....	.....
Rigid or Semi-Rigid Insulation only	.....	.....
Drywall and Insulation.....	.....	.....
Other (please specify)_____	.....	.....
8.3 Wall panel assembly location?		
Factory pre-built.....	.....	.....
Stick-built on site.....	.....	.....
8.4 Wall panel assembly method?		
Welding.....	.....	.....
Screw fasteners.....	.....	.....
Combined welding and screws.....	.....	.....
8.5 Connection between studs and ceiling track ?		
Fixed stud-track connections.....	.....	.....
Connections permitting slab movement	.....	.....
Contractor's choice of connection..	.....	.....

	Buildings less than 4 storeys (check one)	Buildings 4 storeys or taller (check One)
8.6 Top and bottom track attachment to building?		
Power actuated fasteners.....	.....	.....
Embedded anchor bolts.....	.....	.....
Self tapping screws.....	.....	.....
Other (please specify)_____	.....	.....
8.7 Steel bridging between studs?		
Bridging through the knockout.....	.....	.....
Face bridging.....	.....	.....
Nothing.....	.....	.....
8.8 Insulation?		
No insulation.....	.....	.....
Rigid insulation outside stud wall.	.....	.....
Fibre batts within the stud space..	.....	.....
Other insulation (please specify)		
What?_____	.....	.....
Where?_____	.....	.....
8.9 Caulking location?		
Caulking between building and top and/or bottom tracks.....	.....	.....
Not specified.....	.....	.....
8.10 Vapour barrier location?		
Inside stud wall.....	.....	.....
Outside stud wall.....	.....	.....
None.....	.....	.....
8.11 Vapour barrier material?		
Building paper.....	.....	.....
Plastic film (poly).....	.....	.....
Foil-backed drywall.....	.....	.....
Foil-backed insulation.....	.....	.....
None.....	.....	.....
Other (please specify)_____	.....	.....

III. RESPONSIBILITY FOR NEW CONSTRUCTION

Please indicate with a (✓) the answer that best fits your business experience.

10. How often do you encounter the following situations during tendering and construction of steel stud/brick veneer structures?

Type of Problem	Often	Sometimes	Seldom	Never
10.1 No clear description of steel stud wall details is provided in tender drawings or specifications.....	.....	.....	.....	.....
10.2 Steel stud wall details exist, but architectural drawings are not consistent with structural drawings.....	.....	.....	.....	.....
10.3 The breakdown of work between the masonry subcontractor and the steel stud subcontractor is not clearly defined.....	.....	.....	.....	.....
10.4 Standards of material and workmanship expected in the steel stud/brick veneer wall are not clear during tendering.....	.....	.....	.....	.....

11. Which of the following professionals inspect steel stud/brick veneer walls under construction?

	Often	Sometimes	Seldom	Never
11.1 Project architect.....	.....	.....	.....	.....
11.2 Project structural engineer..	.....	.....	.....	.....
11.3 General contractor's inspector.....	.....	.....	.....	.....
11.4 Independent inspection agency.....	.....	.....	.....	.....

12. How often are steel stud/brick veneer walls inspected at each stage of construction?

	Often	Sometimes	Seldom	Never
12.1 At completion of steel stud wall assembly.....	.....	.....	.....	.....
12.2 At completion of steel stud sheathing and insulating.....	.....	.....	.....	.....
12.3 At completion of brickwork...	.....	.....	.....	.....
12.4 No inspection is performed...	.....	.....	.....	.....

13. How often do the specifications require you to supply detailed shop drawings of steel stud/brick veneer walls

Often	Sometimes	Seldom	Never
.....	.....	.....	.....

14. Please indicate with a (√) in each row, which trade is most often responsible for installing the following items?

	Item \ Trade	Drywall	Masonry	Carpentry	Steel	Other
14.1	Steel studs					
14.2	Interior insulation (within studs)					
14.3	Exterior insulation					
14.4	Interior vapour barrier					
14.5	Exterior moisture barrier					
14.6	Flashing					
14.7	Top and bottom track caulking					
14.8	Other caulking at shelf angles, windows					

15. Please use the space below for any comments or opinions you have on the steel stud/brick veneer exterior wall system.

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GROUP D

SURVEY OF STEEL STUD/BRICK VENEER DESIGN AND CONSTRUCTION PRACTICES IN CANADA

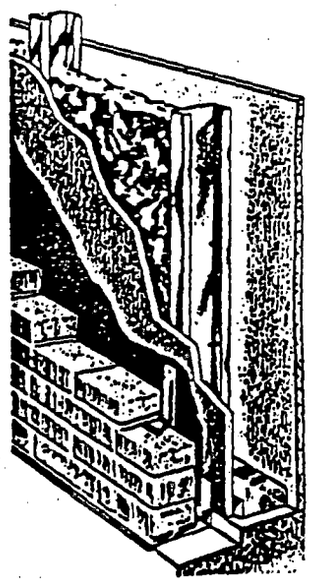
CONTENT

I. Experience with Steel Stud/Brick Veneer Construction

II. In-Service Problems

This questionnaire forms part of a CMHC study of masonry veneer walls supported by steel studs. Advisory Documents, directed to the design and construction industries, will include results of this survey of current practice.

You need not identify yourself to complete the questionnaire. However, if you wish to receive a copy of the Advisory Documents, please indicate your name and business address below or attach your card. A copy will be sent to you as soon as the Advisory Documents are released.



Please return this questionnaire within two weeks to:

Mr. Robert Duncan P.Eng.
Canada Mortgage and Housing Corporation
2nd Floor Annex
National Office
682 Montreal Road
Ottawa, Ontario K1A 0P7

SURVEY OF
STEEL STUD/BRICK VENEER
DESIGN AND CONSTRUCTION PRACTICES
IN CANADA

I. EXPERIENCE WITH STEEL STUD/BRICK VENEER CONSTRUCTION

1. What type of business are you in?

Building Authority..... ☐
Structural Engineering..... ☐
Architectural Design..... ☐
Masonry Contracting..... ☐
Steel Stud Contracting..... ☐
Independent Inspection Agency..... ☐
Other (please specify)_____ ☐

2. Where do you conduct the bulk of your business?

Atlantic Canada..... ☐
Southern Quebec/Southern Ontario..... ☐
Prairie Region/Northern Ontario..... ☐
Pacific Canada..... ☐
Other (please specify)_____ ☐

3. How long have you been involved with wind-bearing steel stud/brick veneer walls?

_____ years

If you have not encountered this system, it is not necessary to complete the questionnaire, but please return it. Thank you.

4. Approximately how many buildings using steel stud/brick veneer exterior walls have you handled? Please provide the number of buildings which fit each of the descriptions given below. Note, some buildings may fit more than one description.

4.1 Total number of steel stud/brick veneer buildings _____

Of these, approximately how many had

4.2 Structural steel frames?..... —
4.3 Structural concrete frames?..... —
4.4 Gravity load-bearing steel stud walls?..... —

Approximately how many are

4.5 Residential buildings?..... —
4.6 Commercial, office, or industrial space?..... —
4.7 Less than four storeys tall?..... —
4.8 Four storeys or taller?..... —

4.9 How long have buildings with steel stud/brick veneer been built in your area?

_____ years

II. IN-SERVICE PROBLEMS

5. Have you ever encountered a steel stud/brick veneer wall which was not performing satisfactorily?

Yes..... ☐ No..... ☐

If yes, please answer the following questions.
If no, thank you for completing this questionnaire.

Please check <u>how often</u> you have seen the following problems on steel stud/brick veneer structures.

	Type of Problem	Never	Seldom	Sometimes	Often
5.1	Brick spalling.....	.....	.....	.....	.....
5.2	Mortar crushing.....	.....	.....	.....	.....
5.3	Vertical masonry cracking.	.....	.....	.....	.....
5.4	Masonry wall buckling.....	.....	.....	.....	.....
5.5	Drywall cracking.....	.....	.....	.....	.....
5.6	Moisture penetration.....	.....	.....	.....	.....
5.7	Efflorescence on masonry..	.....	.....	.....	.....
5.8	Poor door and window mounting.....	.....	.....	.....	.....
5.9	Flashing related problems.	.....	.....	.....	.....
5.10	Absence/plugged weepholes.	.....	.....	.....	.....
5.11	Loose shelf angles.....	.....	.....	.....	.....
5.12	Corroded shelf angles.....	.....	.....	.....	.....
5.13	Corroded studs.....	.....	.....	.....	.....
5.14	Corroded ties.....	.....	.....	.....	.....
5.15	Corroded screws.....	.....	.....	.....	.....
5.16	Discontinuous vapour barrier.....	.....	.....	.....	.....
5.17	Excessive mortar in wall cavity.....	.....	.....	.....	.....
5.18	Wet insulation and drywall	.....	.....	.....	.....
5.19	Air infiltration.....	.....	.....	.....	.....
5.20	Cold bridging.....	.....	.....	.....	.....
5.21	Water infiltration.....	.....	.....	.....	.....
5.22	Leakage at stud tracks....	.....	.....	.....	.....
5.23	Other (please specify)....	.....	.....	.....	.....

6. **Please use the space below for any comments or opinions you have on the steel stud/brick veneer exterior wall system.**

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APPENDIX B: Summary of Survey Results

SUMMARY OF SURVEY RESULTS

The survey results are summarized and reported under similar items to highlight the important findings.

1.0 SURVEY FINDINGS FROM ENGINEERS AND ARCHITECTS

The findings are grouped into the following categories: (1) Construction and materials, (2) Methods of design, and (3) In-service problems.

1.1 Materials Used in the Construction of BV/SS Walls

The selection of studs for residential and commercial buildings was surveyed and the findings are reported in Tables 1-1 and 1-2. For buildings less than 4 storeys, the 92 mm C-stud is the most popular for residential construction and the 152 mm C-stud for commercial construction. For buildings four storeys or taller, the 152 mm C-stud is the most popular choice.

Table 1-1 Choice of Steel Stud for Residential and Commercial Buildings Less Than Four Storeys in Height

Size of Steel Stud	Residential Buildings (%)	Commercial Buildings (%)
	1st Choice	1st Choice
92mm C-stud	[57]	38
152mm C-stud	39	[57]
Other	4	5
Total	100	100

Table 1-2 Choice of Steel Stud for Residential and Commercial Buildings Four Storeys or Taller

Size of Steel Stud	Residential Buildings (%) 1st Choice	Commercial Buildings (%) 1st Choice
92mm C-stud	37	28
152mm C-stud	62	70
Other	1	2
Total	100	100

The spacing of studs is reported in Table 1-3. The most common spacing for steel studs in the BV/SS walls was found to be 400 mm o.c.

Table 1-3 Most Common Stud Spacing

Stud Spacing	Number of Responses	%
300 mm O.C	6	8
400 mm O.C.	53	73
600 mm O.C.	14	19
Other	0	0
Total	73	100

The details around window openings were surveyed with regard to vertical trimmers and the findings are summarized in Table 1-4. The results indicate that the majority of respondents are using double steel stud as a vertical window trimmer.

Table 1-4 Studs Around Window Openings on Buildings

Type of Trimmer	Number of Responses	%
Single studs	10	14
Double studs	57	82
Other	3	4
Total	70	100

The corrosion protection practices for steel studs on projects under construction are reported in Table 1-5. The most popular type of corrosion protection currently in use is galvanizing.

Table 1-5 Current Corrosion Protection Practices for Steel Studs

Type of Corrosion Protection	Number of Responses	%
Paint	0	0
Galvanizing	67	97
Other	2	3
Total	69	100

The materials specified most frequently for use in inner and outer sheathing are reported in Tables 1-6 and 1-7. The most frequently specified materials for both inner and outer sheathing are drywall only and insulation and drywall.

Table 1-6 Inner Sheathing Materials

Type of Inner Sheathing	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Drywall only	53	53
Insulation only	3	0
Drywall and insulation	42	47
Other	2	0
Total	100	100

Table 1-7 Outer Sheathing Materials

Type of Outer Sheathing	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Drywall only	30	28
Rigid or semi-rigid insulation only	24	23
Drywall and insulation	40	43
Other	6	6
Total	100	100

Some assembly, fabrication, erection and detailing methods used in the installation of the steel studs are reported in Tables 1-8 to 1-13. The most popular method of fabrication of BV/SS wall panels is to stick-build the walls on the job site

using screw fasteners. The connection between studs and ceiling track most often used is a connection permitting slab movement. However, fixed stud/ceiling track connections are not uncommon as seen in Table 1-10. The most popular method used to attach top and bottom tracks to the building is the power actuated fastener. Bracing is most commonly installed through the knockouts in the steel studs. The use of fibre batts within the stud spaces is common practice.

Table 1-8 Place of Fabrication of Wall Panels

Place of Fabrication	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Factory pre-built	5	6
Stick-built on site	95	94
Total	100	100

Table 1-9 Methods of Assembly of Wall Panels

Method of Fabrication	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Welding	5	8
Screw fasteners	76	72
Combined welding and screws	19	20
Total	100	100

Table 1-10 Type of Connection Between Studs and Ceiling Track

Type of Connection	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Fixed stud/track connections	31	19
Connection permitting slab movement	63	73
Contractor's choice of connection	6	8
Total	100	100

Table 1-11 Type of Top and Bottom Track Attachment to Building

Type of Attachment to the Building	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Power actuated fasteners	69	70
Embedded anchor bolts	9	6
Self tapping screws	12	14
Other	10	9
Total	100	100

Table 1-12 Type of Steel Bridging Between Steel Studs

Type of Bridging Between Steel Studs	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Bridging through the knockout	67	66
Face bridging	21	20
No bridging	12	14
Total	100	100

Table 1-13 Type of Insulation

Type of Insulation	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
No insulation	0	0
Rigid insulation outside stud wall	33	33
Fibre batts within the stud space	65	63
Other insulation	2	4
Total	100	100

The use of caulking between top and bottom tracks is reported in Table 1-14. The results indicate that caulking in these locations is specified in about 80% of the cases.

Table 1-14 Presence of Caulking at Top and Bottom Tracks

Presence of Caulking	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Caulking between building and top and/or bottom tracks	79	80
Not specified	21	20
Total	100	100

The location of the vapour barrier in the BV/SS wall system is reported in Table 1-15. It was found that most people specify the vapour barrier to be on the inside face of the steel studs.

Table 1-15 Vapour Barrier Location

Location of Vapour Barrier	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Inside stud wall	89	87
Outside stud wall	11	13
No Vapour Barrier	0	0
Total	100	100

The survey also investigated the types of materials used as vapour barrier and the results are shown in Table 1-16. The plastic film (poly) is the most popular alternative used as vapour barrier in BV/SS walls.

Table 1-16 Materials Used as Vapour Barrier

Material	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Building paper	0	2
Plastic film (poly)	84	85
Foil-backed drywall	10	7
Foil-backed insulation	0	0
No Vapour Barrier	0	0
Other	6	6
Total	100	100

The survey sought information on whether any exterior water repellent treatment was being used on brick veneer in BV/SS wall construction. As seen in Table 1-17 the results indicate that in the majority of cases no water repellent treatment is specified.

Table 1-17 Materials used as Exterior Water Repellent Treatment

Material	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
None	73	72
Silicone or organic coatings	18	18
Silanes or siloxanes	0	2
Acrylic water repellents	6	4
Other	3	4
Total	100	100

The type of brick ties used in the construction of BV/SS walls was surveyed and the findings are summarized in Table 1-18. The adjustable ties screwed to studs are most popular followed closely by adjustable ties engaged directly with the stud.

Table 1-18 Type of Brick Ties

Type of Brick Tie	Number of Responses	%
Corrugated strip tie	14	21
Adjustable tie, screwed to stud	29	44
Adjustable tie, directly engaged with stud	23	35
Other	0	0
Total	66	100

The type of corrosion protection used for brick ties are reported in Table 1-19. The survey results indicate that galvanizing is by far (over 90%) the most often used corrosion protection.

Table 1-19 Brick Tie Corrosion Protection

Type of Corrosion Protection	Number of Responses	%
Galvanizing	63	91
Cadmium plating	2	3
Stainless steel	4	6
Nothing	0	0
Total	69	100

1.2 Methods and Criteria Used in the Design of BV/SS Walls

The question as to which party most frequently designs BV/SS walls was surveyed and the findings are reported in Table 1-20. It appears that the project architect most often designs the BV/SS walls. The project structural engineer seems to be given this responsibility in less than 30% of the cases.

Table 1-20 Who Designs BV/SS Walls?

Consultant	Number of Responses	%
Project architect	58	65
Project structural engineer	25	28
Sub-contractor's structural engineer	4	5
Other	2	2
Total	89	100

The party which most frequently reviews/inspects BV/SS walls under construction is reported in Table 1-21. The inspection/review of BV/SS walls under construction again is most often performed by the project architect.

Table 1-21 Who Inspects/Reviews BV/SS Walls During Construction

Consultant	Number of Responses	%
Project architect	119	82
Project structural engineer	21	14
Sub-contractor's structural engineer	1	1
Independent inspection agency	3	2
No inspection performed	2	1
Other	0	0
Total	146	100

The stages of construction at which inspections/reviews are performed are reported in Table 1-22. The survey indicates that the inspection/review of BV/SS walls is performed at different stages of construction. The present practice for inspection/review is raising some questions.

Table 1-22 At What Stage of Completion are Inspections Performed

Construction Stage	Number of Responses	%
At completion of steel stud wall assembly	46	39
At completion of steel stud sheathing and insulating	29	25
At completion of brickwork	22	19
No inspection performed	4	3
Other	17	14
Total	118	100

The maximum lateral stud deflection permitted under design wind load is reported in Table 1-23. The survey indicates that a limit of L/360 is most often specified.

Table 1-23 Maximum Lateral Stud Deflection Permitted Under Design Wind Load

Lateral Deflection	Number of Responses	%
L/240 or greater	7	10
L/360	37	55
L/600	13	19
L/720	5	8
Other	5	8
Total	67	100

Where L is the height of a simply supported steel stud.

The requirements for shop drawings were surveyed and the findings are reported in Table 1-24. The results indicate that shop drawings are not often required in the specifications for BV/SS walls.

Table 1-24 Shop Drawing Requirements in Project Specifications

Shop Drawing Requirement	Buildings less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Always	15	16
Often	2	7
Sometimes	12	16
Seldom	33	28
Never	37	33
Total	100	100

The trade which is most often responsible for installing the different components of the BV/SS walls was surveyed and the findings are reported in Table 1-25. The survey indicates that the drywall and masonry contractors are most often responsible for constructing and installing the components of the BV/SS walls. Therefore, any training should be directed towards these trades.

Table 1-25 Who is Installing What in the Construction of BV/SS Walls

Item \ Trade	Drywall (%)	Masonry (%)	Carpentry (%)	Steel (%)	Other (%)
Steel Studs	83	0	8	8	1
Interior insulation (within studs)	76	0	8	2	14
Exterior insulation	34	37	9	12	18
Interior vapour barrier	73	2	11	2	12
Exterior moisture barrier	21	53	15	0	11
Flashing	9	81	2	0	8
Top and bottom track caulking	72	3	7	2	16
Other caulking at shelf angles, windows	17	27	7	2	47

The responses of professionals to the question of information and research requirements are reported in Tables 1-26 and 1-27. Clearly there is a common demand for more information and research on the BV/SS wall system.

Table 1-26 Is More Information Required on the BV/SS Walls?

Response	Number of Responses	(%)
Yes	62	85
No	11	15
Total	75	100

Table 1-27 Has Adequate Research Been Carried Out on the BV/SS Walls?

Response	Number of Responses	(%)
Yes	10	14
No	63	86
Total	75	100

The standards or guidelines currently used by Engineers and Architects in the design of the BV/SS walls are reported in Table 1-28. At present most engineers and architects use product catalogues and industry publications.

Table 1-28 Standards or Guidelines Currently Used in the Design of BV/SS Walls

Standards or Guidelines	Number of Responses	(%)
Product catalogues and industry publications	33	34
CSA standards, NBC codes and publications, local codes and building practices and CMHC reports and publications	26	27
Past and current research findings	5	5
No codes, but common sense and intuition	13	13
Masonry Institute publications and literature	7	7
Architectural standards and specifications, foreign codes and guidelines	6	6
Structural engineer's opinion	8	8
Total	98	100

The most common problems encountered with the construction of the BV/SS walls are reported in Table 1-29. The results indicate that excessive stud deflection due to wind load is not a common problem. The most common problems are poor workmanship and inexperienced tradesmen. This points to the urgency for more education and technology transfer.

Table 1-29 Most Common Problems Encountered with the Construction of the BV/SS Walls

Problems	Number of Responses	(%)
Poor workmanship and installation, inexperienced tradesmen, wrong trade, non-compliance with specifications	29	31
Inadequate ties and tie connections	15	16
Inadequate stud thickness, framing for openings (for services and windows) and bridging	8	9
Inadequate connections and anchoring	7	7
Excessive stud deflection due to wind load	2	2
Inadequate waterproofing and corrosion protection; air/vapour barrier and insulation discontinuity	19	20
Other	14	15
Total	94	100

1.3 In-Service Problems

The survey was to determine whether the respondents had ever investigated a BV/SS wall which was not performing satisfactorily. The findings are reported in Table 1-30. It appears that the majority of the respondents have investigated a BV/SS wall system that was not performing satisfactorily.

Table 1-30 Was an Investigation ever Performed on a BV/SS Wall Which was not Performing Satisfactorily

Response	Number of Responses	(%)
Yes	27	66
No	14	34
Total	41	100

The frequency of some specific in-service problems related to the BV/SS walls was surveyed and the findings are reported in Table 1-31. The questionnaire lists many possible problems related to brick veneer construction, but only the problems marked (*) are unique to BV/SS walls. In general, the response to this question was poor and the answers appear to vary a great deal. Overall, the results indicate that air infiltration, discontinuous air/vapour barrier, plugged weepholes and mortar droppings in the cavity are the most common problem. Corrosion of metal components appears to have been observed less frequently. Cracking of drywall, leakage at stud tracks, water infiltration and veneer buckling were encountered least.

Table 1-31 How Often were the Following Problems Observed on BV/SS Walls

Type of Problem	Never (%)	Seldom (%)	Sometimes (%)	Often (%)
Air infiltration	5	0	57	38
Absent/plugged weepholes	19	5	14	62
Discontinuous air/ vapour barrier	0	5	45	50
Excessive mortar in wall cavity	10	2	0	88
Moisture penetration	15	20	25	40
Efflorescence on masonry	5	15	40	40
Flashing related problems	10	0	52	38
Poor door and window mounting	11	16	42	31
Cold bridging	20	12	44	24
Corroded ties	40	25	10	25
Vertical masonry cracking	15	35	25	25
Corroded shelf angles	38	14	24	24
Corroded studs *	38	19	19	24
Wet insulation and drywall	11	26	42	21
Corroded screws *	45	15	20	20
Water infiltration	13	33	38	16
Loose shelf angles	28	36	18	18
Drywall cracking	15	25	45	15
Leakage at stud tracks *	9	50	32	9
Masonry wall buckling	40	15	40	5
Brick spalling	29	33	38	0
Mortar crushing	33	29	38	0

2.0 SURVEY FINDINGS FROM MASONRY CONTRACTORS

A similar approach as in Section 1.0 will be used to report the survey findings in this section. Our findings are grouped into the following categories: (1) Construction materials, and (2) Responsibility for new construction.

2.1 Materials Used in the Construction of BV/SS Walls

The findings on spacing of the steel studs in the construction of BV/SS walls are reported in Table 2-1. The most common stud spacing appears to be 400 mm o.c. This is in agreement with the findings from Group A.

Table 2-1 Most Common Stud Spacing

Spacing	Number of Responses	(%)
300 mm O.C.	0	0
400 mm O.C	15	88
600 mm O.C.	2	12
Other	0	0
Total	17	100

The type of brick ties used in the construction of the BV/SS wall system are reported in Table 2-2. The most popular brick tie was found to be the adjustable tie, screwed to the stud. This is in agreement with the findings from Group A.

Table 2-2 Type of Brick Ties

Ties	Number of Responses	(%)
Corrugated strip ties	5	20
Adjustable tie, screwed to stud	17	68
Adjustable tie, directly engaged with stud	3	12
Other	0	0
Total	25	100

The materials used for water repellent treatment for brick veneer are reported in Table 2-3. It was found that water repellents for brick veneer is still in use by a high proportion of the respondents. These findings are not in agreement with the findings from Group A.

Table 2-3 Water Repellents Used for Brick Veneer

Water Repellents	Number of Responses	(%)
No Repellents	10	53
Silicone or organic coatings	8	42
Silanes or siloxanes	0	0
Acrylic water repellents	1	5
Other	0	0
Total	19	100

The question on brick tie corrosion protection used in the BV/SS walls was surveyed and the findings are reported in Table 2-4. Galvanizing is the most popular choice. This corresponds to the findings from Group A.

Table 2-4 Brick Tie Corrosion Protection

Corrosion Protection	Number of Responses	(%)
Galvanizing	13	54
Cadmium plating	7	29
Stainless steel	3	13
No Protection	1	4
Total	24	100

2.2 Responsibility for New Construction

The survey sought some information on whether the breakdown of work was well defined between masonry and steel stud/drywall subcontractors. The findings are reported in Table 2-5. While some problems were acknowledged to exist in the work breakdown between masonry and steel stud/drywall contractors, the masonry contractors did not perceive the problem to be major. The

response from steel stud/drywall contractors is discussed in Section 3.2.

Table 2-5 Breakdown of Construction Work on BV/SS Walls Between Masonry and Steel Stud/Drywall Contractors is Not Clearly Defined

Response	Number of Responses	(%)
Often	4	20
Sometimes	5	25
Seldom	5	25
Never	6	30
Total	20	100

The survey also sought to determine if the standards of materials and workmanship expected were clear during tendering. The survey findings are reported in Table 2-6. The respondents appear to be split on the answer as to whether or not standards of materials and workmanship expected in the construction of BV/SS walls are clearly defined during tendering.

Table 2-6 Expected Standards of Materials and Workmanship are Not Clearly Defined During Tendering

Response	Number of Responses	(%)
Often	5	25
Sometimes	5	25
Seldom	3	15
Never	7	35
Total	20	100

The findings to the question on which of the professionals inspects BV/SS walls during construction are reported in Table 2-7. The survey shows that the project architect and the general contractor's inspector most often inspect BV/SS walls during construction. Independent inspection agencies seem to perform this function rarely.

Table 2-7 Which of the Professionals Inspects BV/SS Walls During Construction

Professional	Often (%)	Sometimes (%)	Seldom (%)	Never (%)
Project architect	56	25	19	0
Project structural engineer	7	57	29	7
General contractor's inspector	33	33	17	17
Independent inspection agency	0	27	18	55

The frequency of inspection at each stage of construction is reported in Table 2-8. The survey shows that no standardized procedures for BV/SS wall inspection exists. These findings correspond with the findings from Group A.

Table 2-8 Frequency of Inspections During Construction of the BV/SS Walls

Stage of Construction	Often (%)	Sometimes (%)	Seldom (%)	Never (%)
At completion of steel stud assembly	58	17	25	0
At completion of steel stud sheathing and insulating	22	50	14	14
At completion of brickwork	50	22	14	14
No inspection is performed	33	22	11	33

The trade which is most often responsible for installing the different components of the BV/SS walls is reported in Table 2-9. The findings show that masonry and drywall contractors are most often involved in the construction of BV/SS walls. This agrees well with the findings from Group A.

Table 2-9 Who is Installing What in the Construction of the BV/SS Walls

Item \ Trade	Drywall (%)	Masonry (%)	Carpentry (%)	Steel (%)	Other (%)
Steel studs	[94]	0	6	6	0
Interior insulation (within studs)	[65]	0	23	0	12
Exterior insulation	22	[61]	11	6	0
Interior vapour barrier	[76]	6	18	0	0
Exterior moisture barrier	12	[82]	6	0	0
Flashing	0	[100]	0	0	0
Top and bottom track caulking	25	6	13	6	[50]
Other caulking at shelf angles, windows	0	13	37	0	[50]

3.0 SURVEY FINDINGS FROM STEEL STUD/DRYWALL CONTRACTORS

A similar approach as in Section 1.0 will be used to present the survey findings in this section. The findings are grouped into the following categories: (1) Construction materials (2) Responsibility for new construction.

3.1 Materials Used in the Construction of BV/SS Walls

The steel stud spacing used in BV/SS walls is reported in Table 3-1. The most common spacing is 400 mm o.c. This agrees with the findings from Groups A and B.

Table 3-1 Steel Stud Spacing

Spacing	Number of Responses	(%)
300 mm O.C.	2	12
400 mm O.C	10	63
600 mm O.C.	3	19
Other	1	6
Total	16	100

The types of vertical trimmer around window openings in BV/SS wall buildings are reported in Table 3-2. The most common vertical trimmer around window openings consists of a double stud. This agrees with the findings from Group A.

Table 3-2 Type of Vertical Trimmer Used Around Window Openings

Trimmer	Number of Responses	(%)
Single studs	2	15
Double studs	11	85
Other	0	0
Total	13	100

The corrosion protection materials used on steel studs in BV/SS walls are reported in Table 3-3. Galvanizing is the only corrosion protection for steel stud used by the respondents. This agrees with the findings from Groups A and B.

Table 3-3 Type of Corrosion Protection for the Steel Studs

Corrosion Protection Material	Number of Responses	(%)
Paint	0	0
Galvanizing	13	100
Other	0	0
Total	13	100

The type of materials most often installed as inner and outer sheathing in BV/SS walls was surveyed and the findings are reported in Tables 3-4 and 3-5. The results indicate that drywall and insulation are most often used as inner sheathing and that drywall only is used most often for outer sheathing. These findings agree with the responses from Group A.

Table 3-4 Inner Sheathing Materials

Inner Sheathing Material	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Drywall only	20	31
Insulation only	13	8
Drywall and insulation	60	62
Other	7	0
Total	100	100

Table 3-5 Outer Sheathing Materials

Outer Sheathing Material	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Drywall only	64	64
Rigid or semi-rigid insulation only	22	15
Drywall and insulation	7	14
Other	7	7
Total	100	100

The methods used in the fabrication of the steel stud assembly were surveyed and the findings are reported in Tables 3-6 to 3-10. The survey shows that the steel stud wall is most often stick-built on the job site and that screw fasteners are used most often. These findings agree with the findings from Group A.

Table 3-6 Place of Fabrication of Wall Assembly

Place of Fabrication	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Factory pre-built	10	0
Stick-built on site	90	100
Total	100	100

Table 3-7 Method of Assembly of Wall Panel

Method of Fabrication	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Welding	8	9
Screw fasteners	84	73
Combined welding and screws	8	18
Total	100	100

Table 3-8 Method of Connection Between Steel Studs and Ceiling Track

Method of Connection	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Fixed stud-track connection	21	18
Connection permitting slab movement	72	64
Contractor's choice of connection	7	18
Total	100	100

The use of power actuated fasteners is the most popular choice for attachment of steel tracks to buildings. These findings are summarized in Table 3-9 and they are in agreement with the other groups.

Table 3-9 Method of Top and Bottom Track Attachment to Building

Method of Attachment	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Power actuated fasteners	40	38
Embedded anchor bolts	20	31
Self tapping screws	33	23
Other	7	8
Total	100	100

Bridging methods are reported in Table 3-10. Bridging through the knockout is the most popular method in BV/SS walls. These findings are in agreement with the other groups.

Table 3-10 Type of Bridging Between Steel Studs

Method of Bridging	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Bridging through the knockout	84	64
Face bridging	8	36
No bridging	8	0
Total	100	100

The location of some materials used in the BV/SS walls was surveyed. The findings are shown in Tables 3-11 to 3-14. All of these findings are in agreement with the findings from the previous groups. Fibre batts placed within the stud space constitute the most common type of insulation.

Table 3-11 Location and Type of Insulation

Location	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
No insulation	0	0
Rigid insulation outside stud walls	36	24
Fibre batts within stud space	64	76
Other insulation	0	0
Total	100	100

The presence of caulking in BV/SS walls was surveyed and the responses are summarized in Table 3-12. According to our findings, the majority of respondents use caulking between building and top and/or bottom tracks. These findings are in agreement with other groups.

Table 3-12 Presence of Caulking at Top and Bottom Tracks

Location	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Caulking between building and top and/or bottom tracks	82	90
Not specified	18	10
Total	100	100

Regarding the location of the vapour barrier our findings are summarized in Table 3-13. The survey shows that the vapour barrier in BV/SS walls is most often located on the inside face of the steel stud wall. These findings agree with the responses from the other groups.

Table 3-13 Location of Vapour Barrier

Location	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Inside stud wall	92	100
Outside stud wall	8	0
No Vapour Barrier	0	0
Total	100	100

According to our survey, the most popular vapour barrier material used is the plastic film (poly) as seen in Table 3-14. This finding agrees with the findings of the other groups.

Table 3-14 Type of Vapour Barrier Material

Material	Buildings Less Than 4 Storeys (%)	Buildings 4 Storeys or Taller (%)
Building paper	7	9
Plastic film (poly)	79	82
Foil-backed drywall	0	0
Foil-backed insulation	7	9
No Vapour Barrier	0	0
Other	7	0
Total	100	100

3.2 Responsibility for New Construction

The question of whether a clear description of BV/SS wall detailing in tendering documents exists was surveyed and the findings are reported in Table 3-15. These findings indicate that good detailing does not exist in tendering documents.

Table 3-15 Good Detailing Does Not Exist in Tendering Documents Related to BV/SS Walls

Response	Number of Responses	(%)
Often	5	45
Sometimes	5	45
Seldom	1	10
Never	0	0
Total	11	100

The question of consistency of steel stud details in architectural and structural drawings was surveyed. The findings reported in Table 3-16 indicate that more often than not there exist inconsistencies between structural and architectural drawings with regard to BV/SS wall details.

Table 3-16 Inconsistencies Exist Between Structural and Architectural Drawings Giving Steel Stud Details

Response	Number of Responses	(%)
Often	4	36
Sometimes	3	27
Seldom	3	27
Never	1	10
Total	11	100

The response to the question of whether the breakdown of work between masonry and steel stud/drywall subcontractor is clearly defined is summarized in Table 3-17. The results indicate that from the perspective of the steel stud/drywall contractor the breakdown of work between masonry and steel stud/drywall contractor is not well defined.

Table 3-17 Breakdown of Work Between the Masonry and Steel Stud/ Drywall Contractors is Not Well Defined

Response	Number of Responses	(%)
Often	5	38
Sometimes	4	31
Seldom	3	23
Never	1	8
Total	13	100

Based on Table 3-18, the survey indicates that expected standards of materials and workmanship in BV/SS wall construction are generally not well defined in the tendering documents. These findings are in agreement with the other groups.

Table 3-18 Expected Quality of Work and Standard of Materials is Not Clearly Defined in the Tender Documents

Response	Number of Responses	(%)
Often	6	50
Sometimes	4	34
Seldom	1	8
Never	1	8
Total	12	100

In line with the findings of other groups, steel stud/drywall contractors report that the project architect most often inspects BV/SS walls. The findings of the survey are summarized in Table 3-19.

Table 3-19 Which Consultant Most Often Inspects BV/SS Walls During Construction

Consultant	Often (%)	Sometimes (%)	Seldom (%)	Never (%)
Project architect	42	42	16	0
Project structural engineer	22	44	34	0
General contractor's inspector	40	40	20	0
Independent inspection agency	14	14	43	29

The stage during construction at which inspections are performed was surveyed and the findings are reported in Table 3-20. The findings are similar to those of the other survey groups and they support the statement that no standardized procedures exist for BV/SS wall inspections.

Table 3-20 Stage During Construction at which Inspections are Performed

Stage of Construction	Often (%)	Sometimes (%)	Seldom (%)	Never (%)
At completion of steel stud wall assembly	55	45	0	0
At completion of steel stud sheathing and insulating	40	40	20	0
At completion of brickwork	29	29	42	0
No inspection is performed	0	25	50	25

Responses to the question on which trade is responsible for the installation of BV/SS walls are summarized in Table 3-21. The survey indicates that the work is almost exclusively shared between masonry and steel stud/drywall contractors.

Table 3-21 Trade Most Often Responsible for Installing Components of the BV/SS Walls

Item \ Trade	Drywall (%)	Masonry (%)	Carpentry (%)	Steel (%)	Other (%)
Steel studs	100	0	0	0	0
Interior insulation (within studs)	100	0	0	0	0
Exterior insulation	58	42	0	0	0
Interior vapour barrier	100	0	0	0	0
Exterior moisture barrier	42	58	0	0	0
Flashing	0	64	0	0	36
Top and bottom track caulking	100	0	0	0	0
Other caulking at shelf angles, windows	0	9	9	9	73

4.0 SURVEY FINDINGS FROM BUILDING OFFICIALS AND INSPECTORS

This group was surveyed primarily to determine if they had ever investigated a BV/SS wall which was not performing satisfactorily. The findings are reported in Table 4-1. Interestingly, the majority of the respondents had never inspected a BV/SS wall which was not performing satisfactorily.

Table 4-1 Have You Ever Investigated a BV/SS Wall Which has not Performed Satisfactorily

Response	Number of Responses	(%)
Yes	3	33
No	6	67
Total	9	100

The respondents were asked to list the most common problems encountered with the construction of the BV/SS wall system. While the response to this question is based on a very small sample, it indicates that the problems of moisture penetration, inadequate flashing and absent/plugged weepholes are most frequently observed. Once again, it is to be noted that these problems are not unique to the BV/SS wall system.