

QUALITY ASSURANCE PROTOCOL
TEST DRIVE

Quality by Design

October 18, 2000

A Quality Assurance Protocol for Wood Frame Building Envelopes in the Province of British Columbia

Based on International Standard ISO 9001: 1994

**Applies to quality assurance in design,
project and building site management,
construction, warranty and maintenance.**

NOTES:

1. This document outlines the Protocol & the Quality Manual and refers to the Best Practices Guide and Forms as appropriate.
2. This document constitutes a complete outline of the proposed Protocol. Refer to the Introduction for further details.
3. **This document has been modified based upon applying its content to a project by Polygon Construction Management Ltd. in Vancouver, B.C.**

FOREWORD

Quality by Design was commissioned as the Quality Assurance Protocol by Canada Mortgage and Housing Corporation in order to establish a management system for the assurance of quality of the exterior of multi-storey wood frame buildings located in the coastal climate of British Columbia. This is part of the initiatives undertaken by the Building Envelope Research Consortium, of which CMHC is a prominent member, to address the "leaky condo" issue as it pertains to new construction

The original *Quality by Design* was published in **January 1999**. This current edition has been refined extensively based upon ongoing input from a wide variety of sources. However, in particular, the document has been refined based upon applying it to a real project, a "test drive" as follows:

Greenwich at 5th Residential Condominium Project, Vancouver, B.C.

Design & Construction Team involved in the Test Drive:

Developer/ Builder: Polygon Construction Management Ltd.

Managing Director: Michael Audain

Vice President Construction: Alan Waring

Vice President Development: Brad Tone

Site Superintendent: Henry Schweighardt

Quality Supervisor: David Underhill

Architect: Nigel Baldwin Architects

Principal: Nigel Baldwin, MRAIC

Project Architects: Patrick MacLachlan/ David Roppel

Structural Engineer: Thomas Leung Structural Engineering Inc.

Principal: Thomas Leung, P. Eng.

Building Envelope Consultants: Morrison Hershfield

Principal: Richard Taylor, P. Eng.

Project Engineer: Stephane Hoffman, P. Eng.

Project Inspector: Andy Lang

Certified Professional: Steven Hart Architect Inc.

Principal: Steven Hart, MAIBC, CP

We believe the *Quality by Design* is important for these reasons:

- It brings together thinking about building envelope quality from a representative sample of all of the design and construction professionals who produce building envelopes;
- It is designed to be practical and usable;
- It is designed as a basis to be built onto by designers, builders, suppliers and installers of the building envelope. It is not exclusive nor does it exclude anyone involved in building envelopes from "buying in";
- It is based on a recognized international standard, ISO 9001:1994, which is a quality system standard likely to become prevalent in Canada in the next few years. Persons adopting the Protocol will find it eases their future adoption of ISO 9001;

Although this Protocol is focused on the exterior of multi-storey wood frame buildings, i.e., their "building envelope", it has been designed such that its use could be expanded to other building forms as well as to other aspects of design and construction practice. The Quality Manual portion of this Protocol will be available on disc to purchasers, allowing them to customize it to their needs

A major challenge in developing this Protocol was simply to define what it is and consists of. The first paragraph above provides as good a definition as any. As a minimum, the Protocol includes the following documents:

- 1 This Introductory document;
 - 2 The Quality Manual;
 - 3 The Best Practices Guides;
- Published separately by CMHC*
- 4 Associated Forms.

Contained in the appendices to this document.

Items 1 and 2 are specific products of our contract with CMHC. Item 3 is being developed concurrently by others and consists, so far, of Best Practice Guides for Wood Frame Construction in B.C., for Flashings, and for EIFS. Item 4 has been introduced with the Quality Manual, however each adopter of the Quality Assurance Protocol will probably add to its content in association with the particulars of their building envelope involvement.

Since a Quality Assurance Protocol could include other elements, such as a company's Standard Operating Procedures, detailed Work Instructions, considerations of collective agreements, etc., it is perhaps best to envision the QAP as being a vessel to contain elements of a range of thinking, i.e.:

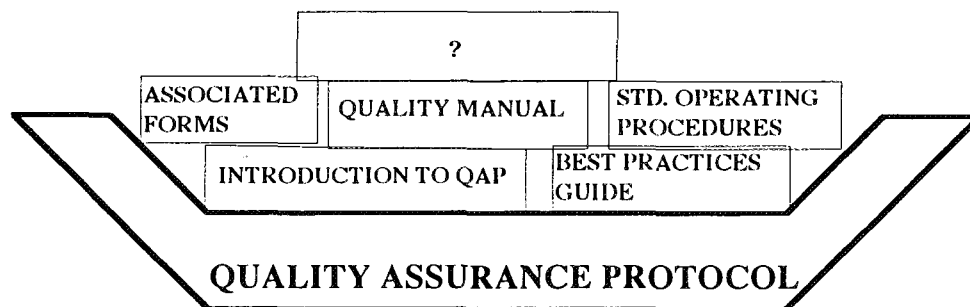


Figure F-1: The Quality Assurance Protocol

ACKNOWLEDGMENTS

This document was prepared by Pro Pacific Architecture Limited under contract to Canada Mortgage and Housing Corporation. Principal investigators for the project were Brian Palmquist, MAIBC, MRAIC, CP, President of Pro Pacific and William A. Gies, MAIBC, CP, assisted by quality systems consultant Arc Rajtar of QUEXX International. The "test drive" revisions were prepared by Brian Palmquist.

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CMHC PUBLICATION

ISBN _____

1 INTRODUCTION

What is it? - A Quality Assurance Protocol is a set of recommendations and guidelines which, if followed, will assure an improved level of quality in design, construction and maintenance.

Who is it intended for? This Quality Assurance Protocol is intended for use by Building Envelope Designers, Builders, Suppliers and Installers in the Province of British Columbia (see definitions below). In this Protocol, where a recommendation or guideline applies to any of these parties, then that party is called a "Building Envelope Provider". Where a recommendation or guideline applies to one or more of these parties in their traditional roles, then the traditional names are used.

Where does it apply? - This Protocol deals more specifically with quality system requirements for the exterior of wood frame multi-residential buildings for quality assurance purposes. However, most of the protocol is usable on virtually any building project.

When should it be used? - The quality system requirements specified in this Protocol are complementary (not alternative) to the requirements specified in traditional design and construction documents, however their adoption may lead to modifications in those documents and associated practices. Where appropriate, this Protocol refers the user to the "Best Practices Guide" [insert exact title when determined] for specific guidance. The quality system requirements specify the base elements which any quality system should encompass, but it is not the purpose of this Protocol to enforce uniformity of quality systems.

This Protocol is generic. The complexity of a quality system developed for any specific organization will be influenced by the needs of that organization, the products and services it supplies, and the processes and specific practices it employs. For example, a quality system for a material supplier with one product line may be somewhat simpler than that of the general contractor using that material and dozens of others.

This Protocol also specifies quality system requirements for use where a Building Envelope Provider's capability to design and/or construct a durable wood frame building envelope needs to be demonstrated. The requirement for demonstrating capability is emerging in reaction to real problems with recently constructed building envelopes, and it is anticipated this requirement will become general in the next few years.

The specified quality system requirements are primarily aimed at achieving improved customer satisfaction by reducing or preventing non-conforming and non-performing building envelopes at all stages from design through to occupancy and maintenance.

How is it to be used? - There are many approaches possible to applying this Protocol to the activities of a particular individual or company. CMHC has commissioned the authors of the Protocol to also prepare teaching materials for a course built around the Protocol, which will include practical examples of Protocol applications.

Each building is unique and each Building Envelope Provider has a unique role to play. If we were to think of each building's design and construction as telling a story, then each provider is a character who participates in the story in a unique way, provides unique input and helps in telling the overall story. The purpose of this Protocol is to ensure each building story has a happy ending which, like a bedtime story, helps customers, clients, occupants and providers alike sleep easier and deeper in the knowledge that they have designed/ built/ inhabited a better building.

INTRODUCTION

Qu'est-ce qu'un protocole d'assurance de la qualité? Il s'agit d'un ensemble de recommandations et de directives qui, si elles sont suivies, assureront une meilleure qualité dans les domaines de la conception, de la construction et de l'entretien.

À qui ce protocole s'adresse-t-il? Il s'adresse aux concepteurs, aux fabricants, aux fournisseurs et aux poseurs, de la Colombie-Britannique, dans le domaine de l'enveloppe du bâtiment (voir les définitions ci-dessous). Dans le présent protocole, lorsqu'une recommandation ou une directive s'applique indifféremment à l'un ou l'autre de ces intervenants, on utilise le terme « fournisseur d'enveloppe du bâtiment ». Lorsqu'une recommandation ou une directive se rapporte à un ou à plusieurs intervenants dans leur rôle traditionnel, alors ceux-ci sont désignés par leur appellation traditionnelle.

Quel est l'objet de ce protocole? Ce protocole s'applique particulièrement au revêtement extérieur des collectifs d'habitation à ossature de bois, pour les besoins d'assurance de la qualité. Toutefois, ce protocole peut s'appliquer, pour une bonne part, à n'importe quels travaux de construction.

Quand faut-il l'appliquer? Les exigences stipulées dans le présent protocole servent à compléter (et non pas à remplacer) les exigences énoncées dans les documents normatifs usuels en matière de conception et de construction. L'adoption de ces exigences peut toutefois entraîner la modification de ces documents et des pratiques visées. Lorsqu'il sera pertinent de le faire, le protocole renvoie l'utilisateur ayant besoin de directives additionnelles au *Guide des règles de l'art* (à l'heure actuelle, le *Guide des règles de l'art* n'a pas été publié dans sa version finale). Les exigences en matière d'assurance de la qualité stipulent les éléments de base que tout système d'assurance de la qualité doit posséder, mais le protocole ne vise pas à imposer l'uniformité des systèmes d'assurance de la qualité.

Le protocole est un document générique. La complexité du système d'assurance de la qualité mis en place dans une entreprise dépendra de ses besoins, des produits et services qu'elle offre, et des procédés et pratiques qu'elle applique. Ainsi, un système d'assurance de la qualité chez un fournisseur n'offrant qu'un seul produit sera vraisemblablement plus simple que celui d'un entrepreneur général utilisant ce produit et des douzaines d'autres.

Le protocole stipule également les exigences en matière de système d'assurance de la qualité à mettre en oeuvre lorsque la capacité d'un fournisseur d'enveloppe du bâtiment à concevoir et à construire une enveloppe de bâtiment à ossature de bois durable doit être démontrée. Cette exigence est formulée parce qu'il a été établi que

l'enveloppe de bâtiments récemment construits présentait des défauts réels. On prévoit que cette exigence se généralisera d'ici quelques années.

Les exigences stipulées en matière de système d'assurance de la qualité visent principalement à mieux satisfaire le client en réduisant ou en éliminant les éléments non conformes et les défaillances de l'enveloppe à toutes les étapes de la durée utile des bâtiments, de la conception jusqu'à l'occupation et à son entretien ultérieur.

Comment le protocole est-il appliqué? Il existe de nombreuses méthodes possibles pour appliquer le protocole aux activités d'une personne ou d'une entreprise. La SCHL a chargé les auteurs du protocole de préparer du matériel de formation en prévision d'un cours sur le protocole qui inclura des exemples pratiques d'application.

Chaque immeuble est unique et chaque fournisseur d'enveloppe du bâtiment a un rôle unique à jouer. Si nous faisons une analogie entre le récit d'une histoire et la conception et la construction de chaque bâtiment, alors chaque fournisseur est un personnage qui prend part à l'histoire d'une manière unique, qui fait une contribution unique et qui aide à raconter l'ensemble de l'histoire. Le but de ce protocole est de s'assurer que l'histoire de chaque bâtiment finit bien. Comme un conte raconté aux enfants au moment de se mettre au lit, le protocole aidera les consommateurs, les clients, les occupants et les fournisseurs à dormir profondément, du sommeil de celui qui sait qu'il a conçu, qu'il a construit et qu'il occupe une habitation de meilleure qualité.

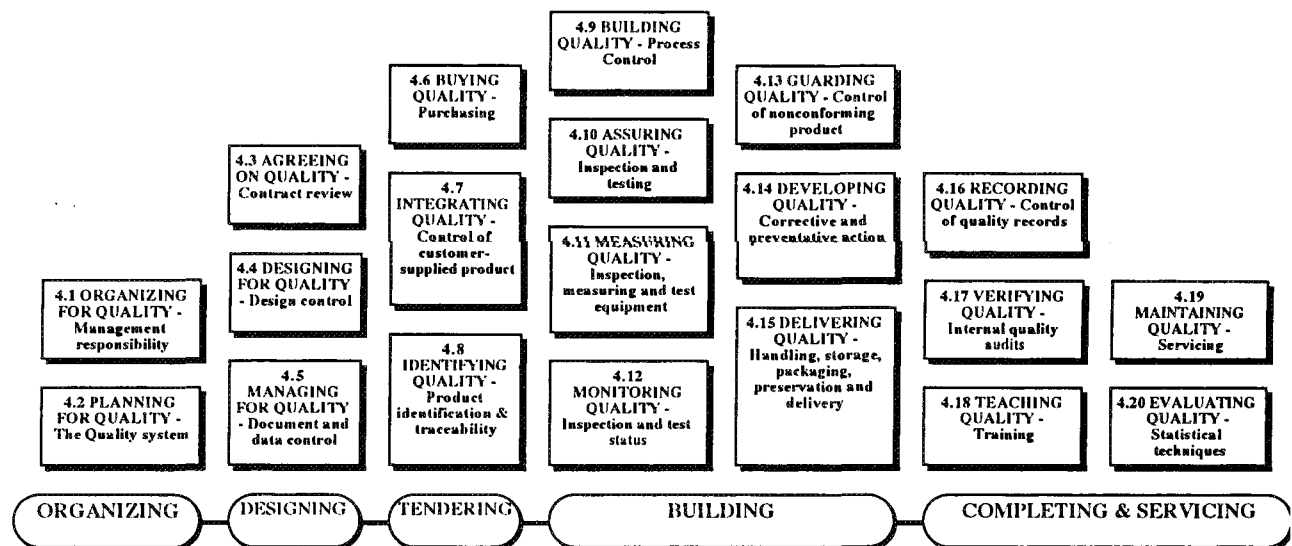
2 REFERENCE

ISO (International Standards Organization) is a worldwide federation of national standards bodies (ISO member bodies). This Quality Assurance Protocol for Building Envelope Designers, Builders, Suppliers and Installers in the Province of British Columbia is prepared in keeping with International Standard ISO 9001: 1994 requirements, which are intended to assure quality in organizations involved in design and/or production.

The ISO format was selected for these reasons:

1. After analyzing alternatives including various TQM (Total Quality Management) systems, it was determined that ISO 9001 best encompassed nearly all of the circumstances surrounding building envelope design and construction (one section was added to deal with areas not considered by ISO 9001);
2. ISO certification has started in Canada and is expected to be mandated by many governments and institutions in the next few years. It is already mandatory in many countries. Building Envelope Providers who adopt this Protocol will not have met all ISO certification requirements, but this Protocol is organized along ISO lines and nothing in the Protocol is contrary to the ISO philosophy, therefore future ISO certification will be easier for those who adopt the Protocol.

The flow of quality assurance requirements inherent in this Protocol is illustrated by the following diagram(s):



THE QUALITY ASSURANCE PYRAMID

Figure 2.1 - The Quality Assurance Pyramid - an Organizing Structure for the Quality Manual

In order to simplify the organization of the document and its use, we have combined the twenty ISO sections in the square boxes above into 5 chapters carrying the titles in the round-edged boxes at the bottom of the pyramid.

3 DEFINITIONS (in alphabetical order, focused on Building Envelope content)

Builder - an organization or an individual performing construction services for a building project. May be a subcontractor, general contractor, design/build contractor.

Building Envelope - the horizontal, vertical and inclined assemblies which intercede between the interior and external environments.

Building Envelope Provider - any Designer, Builder, Supplier or Installer who is engaged in the provision of products and/or services which contribute to the construction of a building envelope.

Building Envelope Reviewer - an organization or an individual performing building envelope review activities for a building project, including, for example, design review and verification, construction in progress review and verification, submittal review and verification, and pre-occupancy completion/commissioning review and verification. May be an Architect, Engineer, Approved Building Envelope Specialist (in Vancouver), Building Envelope Provider, etc. Should be defined in each instance.

Contract - a documented agreement between two parties (Building Envelope Provider and customer or between two Building Envelope Providers) stipulating goods and/or services to be provided.

Customer - an organization or an individual for whom a Building Envelope Provider works. The Customer need not be the Owner of a project, nor the end user or Occupant of a project.

Designer - an organization or an individual performing design services for a building project. May include Architects, Landscape Architects, Engineers and Specialist Consultants such as Acoustical Consultants, as well as professionals preparing shop drawings or similar in-process design documentation.

Developer - an organization or an individual who assembles the land, resources, financing, design, construction and other expertise required to develop a building envelope.

General Contractor - an organization engaged in the construction of buildings by assembling the necessary material Suppliers and Installers and coordinating their construction efforts to produce a finished building.

Installer - an organization or an individual performing material installation services for a General Contractor or Builder.

Manufacturer - an organization or individual producing building envelope supplies from raw or semi-processed materials. Manufacturers supply suppliers - they do not provide product directly to a Project site.

Mock-up - a partial construction of the proposed building envelope, either in the building fabric or adjacent on the construction site, intended to illustrate interfaces between materials and products as well as construction sequencing.

Occupant - an organization or an individual occupying the completed building envelope.

Owner - an organization or an individual who holds title to a building envelope or a portion of the building envelope (i.e., a dwelling unit). Since an Owner may be absentee, it may be distinct from the Occupant.

Product - goods and services, or combination of goods and/or services, provided by a Contractor, Sub-contractor, Supplier and/or Installer.

Project - a design and construction project incorporating a building envelope component.

Quality Management Representative (QMR) - for each Designer, Builder, Supplier and Installer, the individual designated as responsible for the quality of goods and services supplied to a Project.

Site Superintendent - the individual responsible for the construction activities occurring on a construction site.

Sub-contractor - an organization or an individual performing services for or delivering goods to a General Contractor or Builder.

Submittal - information and/or samples submitted during the course of construction, in support of proposed product design in detail, proposed materials, including warranties, proposed alternatives or substitutions, etc. Traditionally includes shop drawings, manufacturer's literature, samples, sample panels.

Supplier - an organization or an individual delivering goods to a Builder or General Contractor.

4 QUALITY SYSTEM REQUIREMENTS -

Introductory Comments

The Quality Manual which forms a part of the Quality Assurance Protocol which consists of 5 chapters incorporating the 20 Sections adapted from the ISO 9001:1994 standard. Earlier drafts of the Quality Manual had first 22, then 21 Sections, however it became evident that all of the necessary content for the Quality Manual fit neatly within the ISO framework, which helps explain why it has been adopted.

For convenience and to provide an overview of the Quality Manual, these 5 chapters are summarized below. The summary should be reviewed by each individual or organization interested in quality assurance, because it highlights more succinctly the range of issues which must be addressed. Also, since the Quality Manual which expands these 5 chapters may be customized by each participating organization or individual, the summary provides a convenient starting point as well as a reminder of the generic quality principles which any Quality Manual should encompass.

Organization of Quality Manual Chapters

Each of the 5 chapters includes the content of the corresponding ISO 9001 standards, so that users wishing to obtain ISO 9001 certification at a later date may easily translate quality measures based on this document to the ISO 9001 standard.

One of the concerns regarding the initial Draft of this manual was its sheer size. Unfortunately, the refinements associated with the "test drive" have not made it smaller.

To improve the document's usability, the 5 content chapters have been reorganized into a MS Word based outline format allowing the documents to be collapsed into just a checklist, or a checklist with Q-tips (see explanation below) or the full text.

Content of Sections parallels the appropriate ISO section, but has been edited and added to in order to identify more exactly with the design and construction of building envelopes.

Q-Tips are suggestions, tricks and experiences which may assist in the application of the QAP. These are inserted wherever appropriate in each Chapter, and are indented in this fashion. They remain visible when other non-checklist text is hidden by collapsing the document outline.

5 Forms for Quality Management

Introduction - Whether virtual (i.e., on computer) or traditional (i.e., on paper), quality management must rely on forms and formats for its success. The attached forms try to achieve a balance between being generic enough so as to be easily adaptable and all inclusive while being specific enough to be practically useful. Each form is provided in electronic form as well as hard copy, and user feedback and suggestions for improvements are welcomed.

FORMS INCLUDED IN THE QUALITY MANUAL (all in Rich Text Format)

- QUALITY PLAN** - outlines in a table form all of the steps associated with quality assurance implementation
- PURCHASE ORDER**
- BUILDING ENVELOPE DESIGN REVIEW MEETING AGENDA**
- CONTROLLED DOCUMENT DISTRIBUTION LOG** - logs the distribution of documents such as tender and construction drawings
- CONTROLLED DOCUMENT MASTER LIST** - lists all documents which are to be controlled
- CONTROLLED DOCUMENT STAMP** - a facsimile of a rubber stamp which might be affixed to a controlled document
- MASTER FORM LAYOUT** - a template useful for developing other forms as required, with appropriate QAP content
- "HOLD" TAG LOG** - a log of items being held from construction due to quality problems
- CORRECTIVE ACTION REPORT LOG** - a log of items requiring correction during the course of correction
- SUBMITTAL REVIEW** - a recommended form/format incorporating a sample master list of building envelope submittals, designed as a continuous update of submittal requirements
- SUBMITTAL REVIEW** - an alternative format designed to document all information necessary to evaluate an alternative or substituted material/system.
- FIELD REVIEW REPORT** - a recommended form/format combining best practices for field review reporting together with a sample checklist of minimum required building envelope field reviews.
- INSPECTION EQUIPMENT CALIBRATION LABEL** - a rubber stamp or label facsimile to be affixed to inspection equipment regarding calibration data
- INSPECTION EQUIPMENT CALIBRATION RECORD** - a log of calibration activity for test equipment
- INSPECTION EQUIPMENT LOG & CALIBRATION SCHEDULE** - a scheduling document for equipment calibration
- FIELD REVIEW TEMPLATE - BRAINFOREST/PALM** - a .pdf file of a master field review document/checklist we used on a hand held Palm pilot
- FIELD REVIEW CHECKLIST** - a Word print out of the Brainforest checklist, indicating the "tree" structure of the Brainforest outlining tool.

*Quality Assurance Protocol
Test Drive by CMHC &
Polygon Construction
Management Ltd.*

QUALITY MANUAL

to suit ISO 9001: 1994
Updated - October 18, 2000

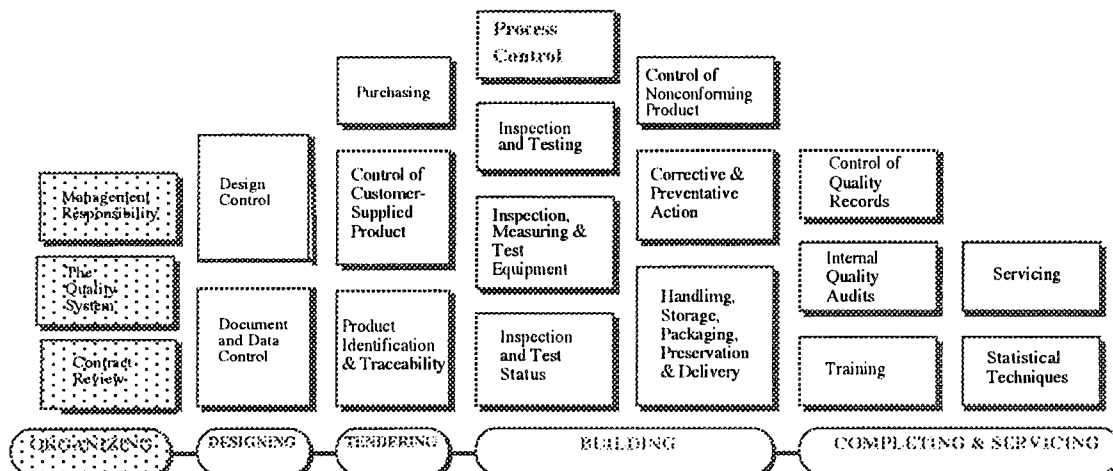
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Chapter 1	ORGANIZING FOR QUALITY	1
Introduction		2
Quality does not just happen. Even after an organization's management and staff are committed to quality, they need the means to implement it - a Quality System. This chapter provides general guidance on establishing, maintaining and monitoring such a Quality System.....		2
Main headings are located at Level 1 and numbered 1.1 and on.....		3
Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.....		3
1.1 Management Responsibility		3
1.1.1 Quality policy		3
1.1.2 The Quality Management Representative (QMR).....		3
1.1.3 Organization		4
1.1.4 Management Review		5
1.2 The Quality System		6
1.2.1 General.....		6
1.2.2 Project Quality System Procedures		7
1.2.3 The <u>Company</u> Quality Plan.....		8
1.2.4 The <u>Project</u> Quality Plan.....		9
1.3 Contract Review		11
1.3.1 Contract Review: Definitions and Purpose		11
1.3.2 Contract Review - Responsibility		12
1.3.3 Contract Review - Procedure.....		12
1.3.4 Contract Review - Building Envelope Amendments		14
1.3.5 Contract Review - Records		14
1.3.6 Contract Review - <u>Balancing Quality and Cost</u>		15

Chapter 1

ORGANIZING FOR QUALITY



THE QUALITY ASSURANCE PYRAMID

Introduction

Quality does not just happen. Even after an organization's management and staff are committed to quality, they need the means to implement it - a Quality System. This chapter provides general guidance on establishing, maintaining and monitoring such a Quality System.

What is ORGANIZING FOR QUALITY ?

- Establishing specific communication strategies to motivate people to listen, think, and interact about quality issues;
- Establishing milestones in the Quality assurance process which require participants to meet face to face;
- Creating a peer pressure structure which fosters performance to a higher level of quality;

Key Concepts -

The Quality Plan - An overall framework for developing and maintaining quality in an organization and on a particular project.

The Project Quality Plan - The framework for developing and maintaining quality in an organization and on a particular project.

The Quality Management Representative (QMR) - The individual in any organization responsible for the organization's quality performance. The QMR may be different people for different customers or projects.

Four Contract Review Criteria to be considered in Contract Review in a Quality conscious environment:

1. Ensuring that contractual requirements are adequately defined and documented and reflect customer expectations, product application, etc.;
2. Identifying and resolving how differences between contract or tender requirements and product/process specifications;
3. Ensuring capability to meet contractual requirements. (This requirement probes the Contractor's ability to complete defined stages of the building envelope within an agreed schedule.)
4. Documenting that the above were considered and addressed.

Value of this Chapter

This introductory chapter to the Quality Manual is based on the International Standards Organization ISO 9001:1994 Quality Standard. Yet, the framework for quality assurance can be simplified and focused for design and construction activities.

For the conscientious Contractor, properly performed Contract Review represents an opportunity to recognize the full implications of costs, quality, construction and warranty to the overall customer's project timing. This approach is well justified as problems that have been experienced with poor quality building envelopes have often been due to the lack of an organized approach to setting out and evaluating construction schedules, realistic cost limits, the Contractor's capacity and capability, and subsequent attempts to adhere to these parameters.

This document is written in Microsoft Word 98 for Macintosh as a Rich text Format (RTF) document. This means that formatting will remain when the document is imported to a PC version of Word.

Preserving the formatting is important, because it makes extensive use of Word's outlining function, as follows:

Main headings are located at Level 1 and numbered 1.1 and on

Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.

☐ Checklist box typical - NOTE: Throughout this Quality Manual, check boxes such as this one are inserted wherever a quality assurance element should be "ticked off."

☐ By collapsing the outline to Level 3 and up, all subsequent data will be hidden and the user will have a simple checklist, which can be expanded at any point if backup material is needed. The checklist format can be printed as a stand alone document, or with the backup information

Q-Tips - are suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Chapter in the form of *Q-Tips* - comments enclosed in boxes like this one.

Printing or viewing the document from Level 4 and up will provide the full checklists plus associated Q-Tips.

Text located at outline level 5 or below, such as this, becomes visible when the outline is further expanded. In this way, detailed explanations, etc. are available to the user without cluttering the basic checklist and Q-Tip content.

1.1 Management Responsibility

1.1.1 Quality policy

☐ Establish a company wide quality policy

The Building Envelope Provider's management defines and documents its policy for achieving quality results in accordance with the format which follows. The organization's **Quality Management Representative (QMR)** ensures that this policy is maintained at all levels in the organization.

The format is important as it follows the ISO 9001 format. If the format is reasonable maintained, future ISO certification becomes much easier.

1.1.2 The Quality Management Representative (QMR)

☐ Appoint one or more Quality Management Representatives (QMR's)

Q-Tip - Who are the QMR's ? - Depending on the organization's size and scope, it would be useful to identify QMR's on business cards and project documentation. If nothing else, adding the designation "QMR" or "Quality Management Representative" will spark some inquiries from clients and colleagues - it has in our case.

The concept of a Quality Management Representative (QMR) is not unique to this Protocol. What may be unique is the concept that the QMR should be identified on all contract and quality related documentation throughout the project.

Q-Tip - Keeping QMR's front & centre - Many of the documents which this protocol recommends be used need to be distributed to various QMR's. We find the easiest way to ensure this is to embed a list of QMR's in the header of our

standard documents.ⁱ Thus, any time they are printed out, the list of QMR's is at hand. Tick boxes may be used to distinguish which QMR's are to receive a particular document.

The more senior the QMR is, the more readily the quality management message will be absorbed by staff. In a small organization, say up to 10 staff, it is best if the QMR is the President, Vice President Quality Assurance or a similar level senior operating officer.

☐ QMR responsibilities:

The Building Envelope Provider appoints a Quality Management Representative with responsibility for quality and, in particular for:

- a) ensuring that a quality *system is established* and maintained;
- b) reporting on the performance of the Quality System to senior management;
- c) monitoring the performance of the quality system on each contract
- d) acting as the contact for Customers in regards to quality issues

This requires that the QMR be named on contracts and related quality documents.

Q-Tip - A QMR "Cheat Sheet" - In the same way that companies often have a "cheat sheet" of in-house contacts for aspects of a project or certain types of information about a project or product, it would be proactive to have a "cheat sheet" of QMR's for each project or product. Then, whenever any inquiry is made, there will always be a contact who can be referred to as "our Quality Manager for that project/product..."

The QMR is identified on each contract, together with appropriate wording indicating the nature of the quality function in the organization.

☐ If the QMR changes, initial duties of the new QMR include:

- a) informing each Customer of the change and any changes to contact information;
- b) reviewing the status of each existing contract

These directions may seem obvious but are essential.

1.1.3 Organization

☐ Define and document the responsibility, authority and the interrelation of personnel who manage, perform and verify work affecting quality on an overall basis and for each Project and/or Customer.

This might be a simple organizational chart or a complex matrix, depending upon the organization. Just developing this kind of chart can often reveal flaws or gaps in the quality assurance approach.

☐ Establish on a company wide basis where this responsibility and authority information is located:

(Name of QMR with overall responsibility)

(Location of QMR/ Tel/Fax/ E-mail)

ⁱ Refer to the Appendix which includes document templates, for samples of this approach.

NOTE: The Quality Manual needs to track its own management.

- ☐ Establish responsibility and authority for Quality on a project by project basis

Who has responsibility for the Quality of each project?

- ☐ Define and document the responsibility, authority and the interrelation of personnel who manage, perform and verify work affecting quality on a particular project.
- ☐ Establish on a Project and/or Customer basis where this responsibility and authority information is located:

(Project / Customer Name)

(Name of QMR responsible)

(Location of QMR/ Tel/Fax/ E-mail)

The assumption here is that there is a Quality Manual dedicated to each project.

1.1.4 Management Review

- ☐ The Building Envelope Provider's management shall review the quality system at defined intervals. Records of such reviews shall be maintained.

Quality system review records are located at:

(Insert location)

Again, management must track its own quality assurance systems.

- ☐ Establish for the company/project (delete one), the quality review as follows: (List dates and sign-off's):

(Date) _____

(Reviewed by) _____

(Date) _____

(Reviewed by) _____

(Date) _____

(Reviewed by) _____

1.2 The Quality System

1.2.1 General

- ☐ Establish, document and maintain a quality system as a means of ensuring that each Project conforms to specified requirements.
- ☐ Prepare a **Quality Manual** covering the detailed requirements of this Protocol. Include or make reference to the quality system procedures in the Quality Manual.

A bit of catch 22 here, but necessary to refer to the Manual of which this Chapter is a part.

Q-Tip - Quality Manual Preparation - Think about the format for a Quality Manual relative to the business. Consider:

- ☐ A business which is primarily an Installer may benefit from a Manual which installers can carry and easily refer to;
- ☐ A supplier's Manual might be built around the size/design of its paperwork;
- ☐ A designer's Manual should match the physical format of its documents;

Q-Tip - Project Filing for any Project - Some years ago we evaluated a number of approaches to filing documentation for our projects, which include traditional architecture, building science, specialized building code analysis, design counseling and lately, earthquake upgrading. We arrived at 10 Phases or Stages which, so far, encompass every project we have worked on, ranging from residential renovations to major planning projects. Our phases (which are neatly contained in bulk-ordered 1-10 numbered binder tabs) are:

1. Administration/ set up/ contracts
2. Planning & planning permission/ scheduling
3. Design/ design development
4. Permitting for construction
5. Tendering/ award of contracts
6. Construction phase and payment certifications
7. Changes to the work
8. Submittals
9. Field reviews
10. Completion/ occupancy/ post occupancy

1.2.2 Project Quality System Procedures

☐ Name a **Project Quality Management Representative (QMR)** as noted above for each Project and/or Customer, and identify that QMR to all parties within and without the organization who have involvement with the Project.

The importance of identifying the QMR for each project cannot be overstated.

☐ Review aspects of the Company Quality Plan which do not work for a specific project, as well as new content for the company plan with the company-wide QMR

The company-wide QMR will:

- ☐ Confirm the exception is appropriate for the Project; or
- ☐ Determine if the exception should be part of the company-wide Plan or some or all Project Plans, and communicate that finding to affected QMR's and company staff affected by the exception.

(Some variations are "one-of's", others are part of ongoing learning).

- ☐ Amend the company wide or Project specific Quality plan to identify changes, and communicate those changes to affected staff, colleagues, etc.

Q-Tip - Communicating Change - Look at the format of a typical press release for ideas about communicating Quality Plan changes. There is no reason why quality improvements should be hid under a bushel.

1.2.3 The Company Quality Plan

Design and construction are complex activities involving a wide range of sizes and types of organization. Yet, the basic requirements for a Quality System are simple and common to all: a Quality Plan defining the organization's approach to quality assurance; a Project Quality Plan refining the general approach on a project by project basis; and a Quality Management Representative responsible for the organization's general and project by project approaches.

- ☐ Develop and maintain an organization-wide **Quality Plan** which:

a) Outlines the responsibilities of the organization needed to meet quality goals, in a format consistent with this Manual;

All readers and users of the Quality Manual need a clear understanding of the quality program.

For an organization-wide Quality Plan, this focus on project oriented process responsibilities rather than job descriptions will help clarify roles, especially to outsiders who are not familiar with or interested in an organization's internal structures.

b) Provides for an indication of dates when responsibilities are required to be completed, as well as a means of indicating they have been attended to;

This may be a one-time schedule for initial set-up of quality systems, or components of a project schedule, or both.

c) Indicates who, both within and without the organization, is responsible for an item or may affect its success;

QMR's in the client and supplier firms dealt with should be identified.

A surprising number of otherwise well managed construction companies have different Provider lists for each project - the reason seems to be the personal experience and preferences of the individual site superintendents.

Q-Tips - Quality Contacts - Most construction shacks have a bulletin board full of business cards and scrawled phone numbers with contacts for all manner of product and service. On a company wide basis or a project by project basis, it would be useful to neaten up that contact list and restrict it to those who have bought into the Quality Assurance Protocol. Initially, this might be an 'A' list and a 'B' list. If the 'A' list were identified as quality companies, preferred suppliers, etc., there would arise pressure to join that 'A' list. If the 'A' list is being developed and maintained by the project/company QMR, there will be a gradual winnowing out of poor quality Providers.

d) Includes sufficient explanatory material in its body so that it is easy to use;

Because the Quality Plan refers back to specific clauses throughout the Quality Manual, and is customizable (it is a Word 5.1a for Mac table documents, easily imported into DOS Word, WordPerfect, etc.), it can become a stand

alone plan for each Project, with perhaps a master being updated to reflect company wide experience.

e) aims to get quality information quickly into the hands of those who must implement it;

Q-Tips - Informal Notation - There is no reason Q-Tips and similar forms of notation injected into design drawings, packaging, assembly instructions, etc., cannot become standard practice. Informal notations already occur all over packaging, buildings under construction, etc., but they are usually not captured for reuse on future work.

f) Ensures that Customers are made aware of the consequences of disregarding information which may adversely affect the quality of the completed Project.

There needs to be a formal communication of consequences in each instance where a Customer appears willing to ignore advice. This is always a tricky communication, but essential.

A sample of the Quality Plan for this Chapter of the Quality Manual is included at the end of this Chapter with explanatory material. Each subsequent Chapter of the Quality Manual has a similar Quality Plan in its body, and there is an overall Quality Plan included in the Forms Appendix appended to this Quality Manual, which is suitable for use on an organization wide or project basis.

1.2.4 The Project Quality Plan

Any Contractor can usually contribute significantly to building envelope quality and costs by taking a pro-active approach to the customer's needs. This often involves recognizing previous experience and past challenges as opportunities for improvement, rather than simply reacting to problems when they are already experienced, which may result in customer dissatisfaction and warranty implications.

Develop and maintain a **Project Quality Plan** for each project which:

- ☐ Communicates the Owner's quality intentions for the project.

For example, is the project for Owner occupancy, lease/rent, sale, etc. Is the intended maintenance regime minimal (self-maintained), periodic (property management company on call), regular (property management on premise) or continuous (resident caretaker). Contradictions between occupancy and maintenance may thus be discovered to exist (e.g., periodic maintenance for a Project with continuous, heavy use).

Q-Tips - A Quality Plan at the Proposal Stage - In our building science practice, our proposals relating to new construction include a few questions about the expected life of the building, the proposed form of tenure, the approach to maintenance, etc. We ask Clients to "fill in the blanks" right at the proposal stage, so that our contract includes key quality expectations from the beginning.

- ☐ Identifies and resolves identified conflicts between quality intentions.

Referring to the Q-tip immediately above, we may have to explain to a Client that durability expectations are inconsistent with the intended maintenance program.

- ☐ Outlines the responsibilities of the organization needed to meet quality goals for a specific Project or Customer, in a format consistent with this Manual;

In most instances this will be a repeat of the company's current version of its overall quality goals. Any instance where the overall goals are changed for a project is a signal that the Project merits careful review.

- ☐ Provides for an indication of dates when responsibilities are required to be completed, as well as a means of indicating they have been attended to;

A schedule by any other name! See the sample Project Quality Plan format appended to each Chapter.

- ☐ Indicates who, both within and without the organization, is responsible for an item or may affect its success

- ☐ Includes sufficient explanatory material in its body so that it is easy to use

There is always a need for continuing education, but all of the "curriculum" needs to be in one place.

- ☐ Summarizes quality acceptance criteria for each element of the Plan;
i.e., when is it good enough?

- ☐ Constitutes an appropriate record or log of quality assurance activities for a project.

It's essential the Manual not be a hard bound seldom used reference book. Flexible formats such as a loose-leaf binder are preferred.

- ☐ Identifies the Coordinating Registered Professional (CRP) responsible in law for the coordination of Project Designers.

This is both a legal requirement and common sense. It's often not clear where "the buck stops" as regards quality decisions.

Depending on the Project, it would be useful to reproduce the sections of the various contracts (Client/Architect, Contractor/Owner) which affect quality control throughout the design and construction phases - could be a substantial appendix!

- ☐ Includes a matrix of who is included in what communications.

Our policy is to include everyone who might possibly be affected - fax and e-mail is cheap, especially compared to litigation.

1.3 Contract Review

This section of Chapter 1 details procedures to be applied to "requests for proposals, tender or quotation" in a manner designed to foster quality in building envelope design and construction. It recognizes that Products and Services may be delivered within a variety of project delivery formats, including:

- *Contractor as General Contractor*
- *Contractor as Design/Build Contractor*
- *Contractor as Construction Manager*
- *Contractor as Project Manager*
- *Contractor as Owner*

☐ Develop Contract Review procedures which are appropriate to any project delivery model which you might be asked to subscribe to.

It is beyond the scope of the Quality Manual to differentiate quality based upon Project Delivery approach. In fact, the approach is seldom known from the outset and often changes, so it becomes important to develop Contract Review procedures which are appropriate to any of these delivery models.

1.3.1 Contract Review: Definitions and Purpose

The purpose of Contract Review to:

- a) *document customer needs and/or requirements;*

What do they want?

- b) *resolve identified discrepancies, if any;*

How does that work?

- c) *ensure that adequate capacity and resources are available to meet on time customer requirements*

How on earth do they expect us to do it in that time frame?

Definitions

"Bid" means a proposal, tender, quotation or bid for the provision of services, products and/or installations for a Project, including professional services.

"Bidder" means an individual or organization in the process of proposing to a Customer a fee for services, products and/or installations

"Bid Documents" means all drawings, specifications, programmes, schedules, addenda, etc., provided to a Bidder as support to the preparation of a Bid.

"Building Envelope Quality /Cost Criteria" means information in Bid Documents which states the Owner's expectations as regards the balance of project costs with expected durability and maintenance requirements.

1.3.2 Contract Review - Responsibility

The Bidder's personnel (generally those with responsibility for Sales) maintain control over and ensure compliance with all relevant procedures related to Contract Review activities. Their activities include:

☐ Assess and confirm the following before submitting any Bid:

- a) general ability to provide required services
- b) availability of the required resources including equipment and skilled personnel with required expertise and experience
- c) available capacity and capability

Realistically, the construction industry has been terrible at all three of these. "Low bid" mentalities and an uncertain marketplace for goods and services cause otherwise reasonable people to kid themselves about these aspects of a bid. A truly effective Quality Plan will allow for these vagaries both in the way the company is operated and its approach to each project.

☐ Review Bid Documents, participate in Bid Preparation and review the final Bid prior to its submission, in order to confirm the Bid provides for a level of quality consistent with the Bidder's Quality Plan and the Owner's quality expectations.

As noted above, try to discern the Owner's/ Client's expectations from the beginning and be explicit about that understanding.

1.3.3 Contract Review - Procedure

☐ Complete Contract Review activities at the Request for Quotation stage (or Invitation for Tender stage) and before acceptance of a contract, and document on a Contract, Purchase Order or Work Order, as appropriate.

☐ Use standard agreement forms where possible

Polygon uses the BCCA No. 200 Subcontract, "Standard Form of Construction Contract between Prime Constructor and Sub-Contractor."

Polygon also attaches to BCCA 200 general criteria such as WCB requirements, insurance requirements. Etc.

☐ Use appendices to standard documents to allow for special conditions and to describe the exact scope of work

Q-Tip - Singing off the same Song sheet - Designers cover their limited responsibility for trade coordination by "related trades" specification sections as well as general notes ascribing coordination to the Builder. Since many building envelope materials/systems are applied by a cast of characters which varies from project to project (e.g., cavity strapping, peel & stick, moisture barrier, window/door installation), it would help to establish a Contractor/material

matrix which could list envelope materials and systems by specification section, and indicate on the other axis which Supplier/Installer was performing that work. This would have the added benefit of revealing the missing links in supply and installation.

- ☐ Ensure contract agreements include:
 - ☐ Quality/Cost Criteria;
- ☐ Durability expectations;
- ☐ Maintenance expectations

Most building envelope insurers are now requiring a building envelope maintenance manual, which is relatively straightforward to assemble as a project unfolds, very difficult and costly to complete after the fact.

- ☐ Combine related activities in contracts and agreements, to reduce the total number of contracts, the dispersion of responsibility and the incidence of coordination problems.

Increasingly, Contractors and Owners are, for example, making one exterior finish Contractor such as the mason or EIFS installer responsible for all of the envelope elements beneath that finish, outside of the structural elements.

Q-Tip - Before you Cover up... - One very successful trade work scope developed by Polygon puts into the same contract all of the elements which need review prior to boarding: insulation; vapour barrier (if used); air tight drywall sealants, foams and gaskets. When Polygon and their Consultant Reviewers perform their preboarding reviews, the Installer accompanies them and corrects deficiencies on the spot. There is no finger pointing when one trade provides all preboarding labour.

1.3.4 Contract Review - Building Envelope Amendments

- ☐ Document expected building envelope performance criteria,

These include:

- ☐ reliability, serviceability and maintainability requirements;
- ☐ permissible deviations, alternatives and substitutions;
- ☐ building envelope acceptance/rejection criteria;
- ☐ appropriate staging of the erection process resulting in readiness for work performed by other trades;
 - ☐ installability;
 - ☐ aesthetic specifications and acceptance criteria ;(quality of finish, excessive gaps and clearances, etc.)
 - ☐ ability to diagnose and correct problems at the stage when correcting them is economical;
 - ☐ use of approved materials and components

- ☐ Note all building envelope amendments to contract agreements, including:

- ☐ Change to customer requirements

Items pertaining to customer needs and satisfaction include:

- ☐ *identification of customer needs expressed through technical specifications*
- ☐ *validation of the design through prototype tests (mock-ups, scale models)*
- ☐ *durability under expected conditions of use and environmental aspects of coastal British Columbia*
- ☐ *consideration of unintended uses and misuses*
- ☐ *compliance with regulatory requirements and related standards*
- ☐ *consideration of problem history to avoid repeating problems with durability of building envelopes*

- ☐ resolved ambiguities or differences

- ☐ modifications to specified and agreed requirements

1.3.5 Contract Review - Records

- ☐ Maintain the following records of Contract Review :

Name	Responsibility
Contract Review	Contractor's Sales Representative
Contract / Tender files	Contractor's Sales Representative / Site Superintendent
Project files	Site Superintendent

1.3.6 Contract Review - Balancing Quality and Cost

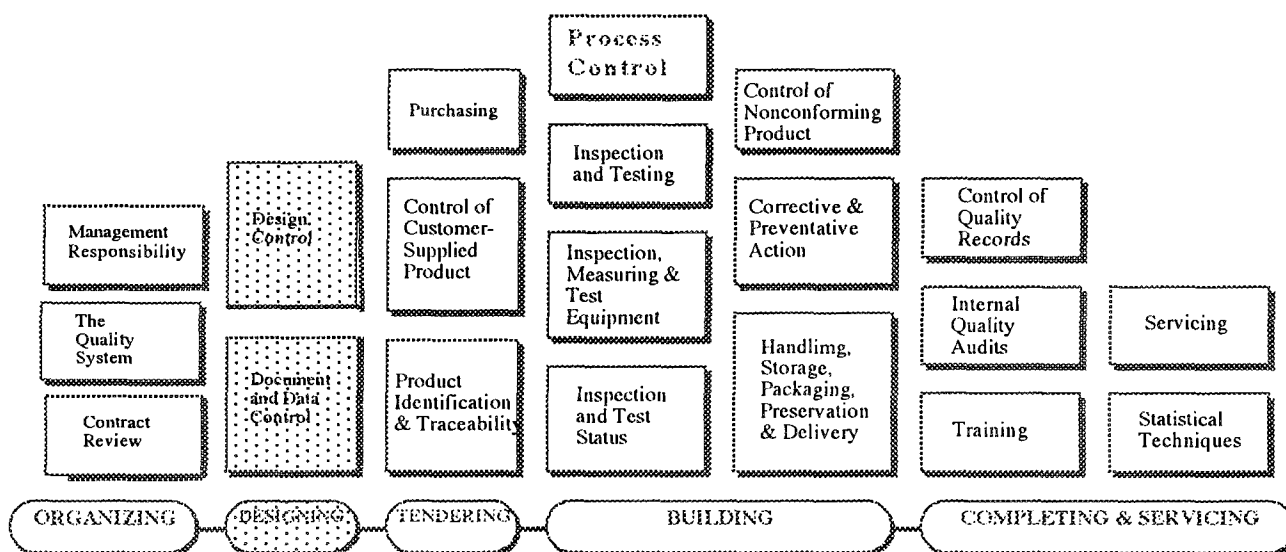
Every Project is a balance between quality and cost considerations. Building envelope performance is usually improved where increased costs are acceptable. The Contract Review phase is probably the first time on each Project where the Quality/Cost equation is addressed.

- ☐ Indicate who within the Bidder's organization is responsible for resolving Quality/Cost conflicts/ issues. When a Bidder's QMR or other personnel preparing a Bid discover an element of the Bid Documents which does not appear to satisfy Building Envelope Quality/Cost Criteria for a specific Project, refer this information to the Bidder's company-wide QMR who will:
 - ☐ Confirm whether or not the element appear to satisfy Building Envelope Quality/Cost Criteria for the Project;
 - ☐ Determine if the element should be reviewed with the Bid Document preparer during the tender period;
 - ☐ If so, contact the Bid Document preparer's QMR to review the element in question;
 - ☐ Clarify the status of the element in question by:
 - ☐ Noting the altered Quality/Cost Balance on the Tender; or
 - ☐ Securing an amendment to the Bid Documents clarifying the anomaly; or
 - ☐ Securing approval for an alternative or substituted product which better meets the Quality/Cost criteria

Chapter 2. DESIGNING FOR QUALITY	2
INTRODUCTION.....	2
Main headings are located at Level 1 and numbered 1.1 and on	5
Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.....	5
2.1. Purpose of Design Control.....	6
2.2. Purpose of Document and Data Control	6
2.3. Building Envelope Design Planning	7
2.3.1. Schematic Design.....	7
2.3.2. Design Development	8
2.3.3. Working Drawings and specifications	9
2.3.4. Construction Documents	11
2.3.5. Commissioning	13
2.4. Design Input	13
2.4.1. Deflection	14
2.4.2. Drainage.....	14
2.4.3. Drying	14
2.4.4. Durability	14
2.5. Design Output	14
2.6. Design Review	15
2.7. Design Verification - SIGN-OFF	16
2.8. Design Validation - MOCKUPS & SUBMITTALS.....	16
2.9. Design Changes.....	17
2.10. Design Control: Records.....	17
2.11. Document and Data Control: Responsibility	17
2.12. Document and Data Control: Procedure	19
2.13. Controlled documents and data: Approval and Issue.....	19
2.14. Controlled documents and data - Changes and Modifications	20
2.15. Document and Data Control - Records.....	20
2.17. Organizational Interfaces	21

Chapter 2.

DESIGNING FOR QUALITY



THE QUALITY ASSURANCE PYRAMID

INTRODUCTION¹

Purposes of This Section

- ☐ To ensure that a project design meets the building envelope requirements of the Client, the end users and society at large.
- ☐ To assist in the development and maintenance of appropriate building envelope document and data control for Designers, Builders, Suppliers and Installers.

What is Building Envelope Design Control?

For the purposes of this Manual, Building Envelope Design Control is defined as *procedures incorporated in the project's design phase in support of appropriate building envelope design, performed by authorized Designers' personnel.*

These activities provide documented input for formal verification and approval by the Client, the Designers and others as appropriate.

Building Envelope Design Control occurs throughout the design phase, and may influence programming, concept planning and design, site planning and detailed design and design development.

It may be that some design control procedures involve specialist consultants or regulatory agencies such as building officials.

What is Document & data control ?

A well-organized Building Envelope Provider needs a document and data control system to ensure that appropriate documents are available wherever they are essential and that any changes to these documents are recorded. Document and data control systems should include documents essential to the design,

construction, assembly, inspection, review and commissioning of a building envelope. Related procedures specify how controlled documents and data are controlled, who is in control, what is to be controlled, where and when.

Q-Tip - Everyone can Count - On the Polygon project, the Architects used a simple numerical system for Site Instructions, Field Reviews, etc., consisting of sequential numbering. In this way, if you received "Instruction No.6" and "Instruction No. 8" you would be prompted to ask for "No. 7." Sounds simple, but surprisingly, this is not a universal practice.

A properly managed document control system should include guidelines for:

- ☐ storage conditions to minimize deterioration and prevent document or data loss.

[Insert your guidelines here]

- ☐ control of electronic controlled documents and data

[Insert your guidelines here]

- ☐ a controlled documents master list

[Insert your guidelines here]

- ☐ defined document change authority

[Insert your guidelines here]

- ☐ access to controlled documents

[Insert your guidelines here]

- ☐ controlled documents retention time

[Insert your guidelines here]

This is an item which may be in part determined by insurance and liability requirements.

- ☐ obsolete controlled documents and data identification

[Insert your guidelines here]

The Building Envelope Provider may also define specific policies concerning:

- ☐ availability and access of records to the Customers and Suppliers.

[Insert your guidelines here]

- ☐ control and identification of changes in regard to various types of documents.

[Insert your guidelines here]

What is the Main Purpose of Building Envelope Design Control?

To enable the Designer to:

- ☐ establish appropriate building envelope design requirements, implement them throughout the design process and

- ☐ obtain appropriate and necessary approvals during and at the completion of the design process.

What is the Main Purpose of Document & data control ?

The quality management system should establish guidelines which will govern document and data control. These guidelines shall define means and methods of identification, collection, indexing, filing, storage, maintenance, retrieval and disposition of pertinent quality documentation and records.

Key concepts -

- ☐ Every Project needs a defined **Water Management Strategy** - that is, a series of concepts and details specifically focused on keeping exterior water out while facilitating the removal of exterior water which inadvertently gets inside the building envelope.
- ☐ Deviations from **Best Practice Guide** details should be verified during the design process, so that valid deviations based on improved/alternative technology are welcomed, unique design is accommodated but without sacrificing the "best" content of BPG details.
- ☐ Effective building envelope design continues throughout the construction stage. It is well understood that because even complete working drawings and specifications generally permit specific choices of systems and products as well as allowing for alternatives and substitutions, they do not constitute final design drawings - hence the emerging requirement for record drawings, which are defined as final design drawings.
- ☐ **Mock-up's** are an essential component of the process. Experience has shown that when the full complement of selected materials and systems arrives on site, adjustments are essential.
- ☐ Controlled documents and data can be in the form of any type of media, such as hard copy or electronic media.
- ☐ Change constitutes unavoidable part of the building projects. Changes to controlled documents and data should be reviewed and approved only by authorized personnel.
- ☐ Whenever practical, the nature of document changes shall be identified on the documents or the appropriate attachments. This requirement applies also to changes, modifications, revisions or additions to the contents of the Quality Manual.

Values of this Section

This record of design responsibility, combined with other records and procedures in this Section and other sections of the Quality Manual provide vital insight into both building envelope design intentions and the execution of those intentions in regards to the building envelope. Their existence may help in circumstances when the building envelope is blamed for warranty or post warranty problems and, in particular, when customer complaints have to be resolved through arbitration. Building Envelope Design Control may be required to comply with local or provincial building and other regulations and may necessitate formal endorsement by authorized regulatory agencies.

Control of design and construction documents constitutes the most critical part of evidence required as proof that a quality system has been effectively implemented. Implementing these recommendations will reduce the incidence of design and construction errors and will improve the efficiency of all parties in monitoring design and construction progress.

This document is written in Microsoft Word 98 for MacIntosh as a Rich text Format (RTF) document. This means that formatting will remain when the document is imported to a PC version of Word.

Preserving the formatting is important, because it makes extensive use of Word's outlining function, as follows:

Main headings are located at Level 1 and numbered 1.1 and on

Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.

- ☐ Checklist box typical - NOTE: Throughout this Quality Manual, check boxes such as this one are inserted wherever a quality assurance element should be "ticked off."
- ☐ By collapsing the outline to Level 3 and up, all subsequent data will be hidden and the user will have a simple checklist, which can be expanded at any point if backup material is needed. The checklist format can be printed as a stand alone document, or with the backup information

Q-Tips - are suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Chapter in the form of ***Q-Tips*** - comments enclosed in boxes like this one.

Printing or viewing the document from Level 4 and up will provide the full checklists plus associated Q-Tips.

Text located at outline level 5 or below, such as this, becomes visible when the outline is further expanded. In this way, detailed explanations, etc. are available to the user without cluttering the basic checklist and Q-Tip content.

Q-Tip - BUILDING BETTER IN VANCOUVER² - It has been estimated that there are more than sixty climates in North America.³ Vancouver's has been well described in the Vancouver Building By-Law, others throughout British Columbia are described in the Supplements to the National Building Code and from local meteorological data. This sort of basic data, taken together with CMHC's evaluation of building failures, the Best Practices Guides and one's own experience and building science knowledge, can be summarized in a general document which might help guide Designers at the earlier stages of a project. The master document can be annotated with information about preferred envelope system alternatives, etc., then edited to suit a particular project. It would also serve as a useful record of the climatic assumptions underlying a design, which may become more important in the face of the significant climatic changes we appear to be experiencing.

2.1. Purpose of Design Control

To ensure that design activities follow documented and maintained procedures in order to meet requirements such as those:

- a) described in CMHC's "Quality Assurance Protocol for the Exterior of Wood Frame Multi-Residential Buildings" (hereafter called 'QAP') of which this Manual is an integral part.
- b) defined in the "Best Practice Guide for Wood Frame Construction in the Coastal Climate of British Columbia" (hereafter called 'BPG')
- c) defined quality intentions and maintenance expectations of Owners and Occupants as defined during contract agreement and review phases.

These requirements are in addition to the standard requirements which are:

- d) specified in contractual agreements, and
- e) reflected in product specifications
- f) inherent in the requirements of regulatory agencies
- g) inherent in the standards referenced by materials and products

Q-Tip - Specifications - One pundit has stated to us that specifications are only read in court. Setting aside the whole issue of specification format (see Q-tip below), perhaps Designer specifications should include editorial comment along the lines of the commentary which is supposed to be edited out of master documents like the NMS specifications. Why not include some educational content in specs., especially during the transition period to a quality assurance protocol? Perhaps a separate font treatment such as the italics used in this document, or the Q-tip boxes, could differentiate between specifications and education, Food for thought.

2.2. Purpose of Document and Data Control

The Purpose of this Section is to describe the Building Envelope Provider's document control policy in order to ensure that documents directly affecting the quality of the building envelope are properly documented, reviewed, approved, distributed and filed.

This procedure applies to both internal and external controlled documents and data, disregarding their origin or type of media, and includes engineering drawings, specifications, standards, building codes and regulations, where applicable.

Internal controlled documents include things like one's own contracts and purchase orders, design documents, etc. External controlled documents include things like municipal assurance letters, building codes, etc.

Classify documents pertaining to the quality of the design, quality assurance and quality control as either:

- ☐ Controlled documents - these documents and/or their copies, which are subjected to control of their issue, review, approval, change and distribution.

Good examples are shop drawings and tender documents.

OR

- ☐ Non-controlled documents - these controlled documents and data which as such are not classified as controlled documents or represent non-controlled copies of the controlled documents which are provided for reference purposes only.

Good examples might include initial sketch designs which are subsequently replaced by formal documents, drafts of formal documents, etc. Obviously, each Building Envelope Provider will need to establish the limits of each category depending on perceived control and record needs.

2.3. Building Envelope Design Planning

- ☐ Clearly identify on the Building Envelope Portion of the Quality Plan⁴ those design stages where decisions affecting the integrity of the building envelope occur, including specific project deadlines and milestones.

Building envelope considerations arise during the following phases or stages of design:

NOTE: novel or unusual items important to building envelope integrity are italicized in bold type like this.

2.3.1. Schematic Design

a) liaising with the customer in design-related matters

- ☐ Establish the expected life of the project in terms of years, generations or mortgages.
- ☐ Establish expected maintenance approaches, i.e., resident caretaker vs. property management company vs. self-maintained.

b) Review of programming information

- ☐ Identify specific programmatic requirements which impact on building envelope design, e.g., high humidity environments, special ventilation requirements, etc.
- ☐ Establish a basic design concept

- i) zoning impacts, i.e., design guidelines, general zoning regulations affecting overhangs, etc.
- ii) marketing and stylistic impacts, i.e., importing a design "look" which originates in another climate
- i) development of a basic design concept for the project.
- ii) Establish the basic building envelope design concept

Q-Tip - Pick an Envelopeⁱ - There are four basic approaches to building a wood frame building envelope so as to satisfy air, moisture and vapour resistance criteria. Clients, Designers and Builders are often unaware that they have these options and unaware of the pro's and con's of each as well as the implications of their use. The basic building envelope concept should be

ⁱ This section is taken from a Bulletin published by Brian Palmquist, the author of this report.

decided very early in the design process, because as you will see, that decision will shape other decisions about materials and design details. The four basic wood frame building envelope concepts are:

Sealed Polyethylene Approach (SPA)

Air Tight Drywall Approach (ADA)

Exterior Air Barrier Approach (EABA)

Exterior Breathable Air Barrier Approach (EBBA)

Building envelope construction will proceed best when Designers have the information to clearly select their preferred building envelope concept early in the process and when Builders understand the implications of theselected concept.

- ☐ Establish the "story" of the design

Q-Tip - The Story of the Design

Traditionally, each member of a design team takes basic instructions from the Client and Coordinating Registered Professional, then proceeds to design those aspects encompassing their expertise. "Coordination" consists of (sometimes hit and miss) meetings wherein everyone's conflicts are (hopefully) worked out. The building envelope is seldom analyzed except in basic mechanical engineering terms.

An alternative approach would be to require each team member to first describe in lay terms their conceptual approach to their portion of the project design, for review with the entire team. Often, basic conflicts in approach exist and may be flushed out by this approach. Potentially conflicting approaches in terms of building code and building envelope may be identified and resolved or identified as challenges. As an example, we discovered on one of our building science projects that the Architect and mechanical engineer each had different and conflicting views about where the interface between interior and exterior spaces lies. An early exploration of the building's "story" might have uncovered this kind of potentially serious inconsistency.

The story of the building should be initially assembled by the CRP for "sign-off" by the owner. This document would also be useful for any consultant dealing in a variety of ways, e.g., engineers interfacing with city utilities depts., architects with city planners and building officials, etc.

Basically, the story of the building would set the groundwork for each participant.

The story should be short enough to fit on one sheet of paper, so each participant can literally pin it to his/her work station and can attach it to a variety of other supporting documentation.

As a check on quality assurance, one would agree that any problems with the story, or proposed amendments, would be treated like Change Orders, i.e., circulated to all for review and comment as to quality, time and budget (hard and soft) implications. The designated parties could sign off revisions for circulation to all concerned.

This may sound a bit ponderous, but it would eliminate a host of downstream problems and always keep the team current on the overall concepts.

2.3.2. Design Development

- ☐ Select building envelope materials and finishing systems
 - i) Basic cladding concepts and a water management strategy

Q-Tip - The Water Management Strategy - Many building leaks arise from discontinuous water paths. In short, water is picked up by a gutter, drain or scupper, then unceremoniously dumped on the ground (over habitable space) or another roof (causing premature wear to the roofing materials) or worst of all, somewhere on the building face. To avoid these type of leaks, determine the path of water hitting any roof or wall of the building, from the point of impact to the storm water drainage system. Typically, discontinuities become quickly obvious and may then be resolved.

ii) Interface conditions between materials

Q-Tip - There are only 5 good house plans and 30 key details! - We have identified 30 generic detailing conditions which encompass all but the most unusual design configurations of typical wood frame building envelopes. The 30 include below grade, at grade, intermediate floor and roofing conditions, flat and sloped roofs, with/without skylights, balconies, overhangs, mechanical penetrations, open walkways, etc. As a minimum, design development should identify which of the 30 apply to a specific project, as well as any "non-generic" variations. The details not identified and detailed at this stage will become the "Requests for Information", "Changes to the Work" and worse at later phases of the Project. As to the five good house plans, all the rest are variations on the five themes - or they don't work!

- ☐ Establish appropriateness of materials and systems for the selected designs

It is at this stage that the developing design will benefit from BPG details. Refer to the Forms Section of the Protocol for a form which records variations from the BPG details in the proposed design, with reasons. This record has two functions: a) forcing the Designer to evaluate the applicability of BPG details and principles to a specific design; b) validating deviations such that if a problem develops in future, the Designer's rationale is evident.

- ☐ Select and communicate the structural, mechanical, electrical and other engineering systems
 - i) Dimension lumber vs. engineered wood systems
 - ii) Sheathing materials
 - iii) Balcony and walkway systems
 - iv) Horizontal vs. vertical exhaust
 - v) integration of engineering systems into overall system descriptions

2.3.3. Working Drawings and specifications

- ☐ Maintain earlier concepts through working drawings
 - i) Develop details which can be effectively read on site

This requirements tends to favour details on 8-1/2 x 11 or smaller paper.

Q-Tip - Timely Details - One of our favourite site superintendents plans each day's activity at the end of the preceding day. This includes picking out which drawing details are needed for reference the next day and xeroxing them. Next morning he distributes these details to the crews, who carry them off to their work area, post them, refer to them and ultimately abandon them at the day's end, only to have the process repeated the following morning. For the cost of a rented xerox copier and a few reams of paper, the superintendent keeps the right information in front of his workers.

Q-Tip - Educational Details - Although there is still debate over whether it is appropriate for designers to show sequencing of work on their drawings, our evidence is that this approach helps immensely. Often, apparently minor changes to sequencing makes major gains in construction efficiency, which efficiency usually translates into a more sound building envelope. As a variation on the 8-1/2x11 detail sheet, consider 11x17, with the drafting on 1/2 of the sheet, the other 1/2 devoted to explanatory notes, sequencing information, specs., etc. Fold the 11x17 in 1/2 and you have an 8-1/2 x 11 module suitable for a binder, with drawing on one side and supplemental data on the back. Laminate the 8-1/2 x 11 and you have a durable item for the workplace, with the plastic surfaces suitable for markup with adjustments, comments, etc. Collect the marked up sheets and you have a) record drawings and b) a free education on how to improve the details. Give credit (or better, bonuses) to workers who communicate a better way to do the job and you have constantly improving standards and increased respect and co-operation from the workers.

Q-Tip - Code Tips - If construction documents included more building code required information, submittals such as manufacturer's literature, shop drawings, etc., would include fewer discrepancies. Useful designer drawing information includes: minimum/ maximum dimensions where code required; items noted as "not to be moved without prior permission" where codes dictate certain positioning, etc.

☐ Develop appropriate specifications for building envelope design intent

i) Specification which can be effectively read on site

Most engineering specifications are now placed on drawings, which appears to improve their likelihood of being read. Perhaps the stand alone specification is passé.

Q-Tip - OUTLINE SPECIFICATIONS - This document has been written in an outline format, which allows for easy movement of large blocks of related text, etc. Specifications may be organized similarly. In lieu of a large number of discrete documents, a master specification can be organized as a single outline document, with the traditional 16 Divisions as 16 outline Sections, and what would ordinarily be the various specification sections as subsections in the outline. The advantages of this approach include: a) a single source for specification information (ours is about 350k in size and loads in 20 seconds); b) update and new information kept in one location; c) easy reorganization and renumbering via word processing software commands (We use MS Word for Mac - a full specification will renumber in about 1 minute, and generate its own Table of Contents in another).

Q-TIP - Design Concept Notes - Design drawings frequently avoid explaining their priorities. Fabricators regularly produce shop drawings which conflict with design intentions, including building envelope priorities. They have their reasons for what they show, and will show them unless they understand where they conflict with the Designer's concepts. Therefore, Designers would increase the understanding and acceptance of their design concepts if they were more explicit in their explanations. For example, if a Designer wants to minimize vertical post penetrations through a deck, it would be appropriate to note this requirement on design drawings.

Q-Tip - KeyNotes - Various CAD programmesⁱⁱ now include the capability to produce what are called keynotes. These are brief notes about materials, standards and application data, usually organized as per the 16 specifications division format. The notes may be developed once and reused on every project as applicable. Thus, the Designer's body of knowledge can be captured and reused with consistency. Given that, for the moment, few Suppliers and Installer seem to read specifications, keynotes may offer a valid means of accompanying drawings and sketches with essential specifications data.

2.3.4. Construction Documents

- ☐ Maintain earlier concepts through the construction phase
- ☐ Design Mockups like any other design detail

Mock-up's need to be designed as much as buildings, in order to include all or most critical interfaces and material combinations.

ⁱⁱ We use Vectorworks Architect for this purpose. I am sure other platforms offer the capability.

☐ Detail and document resulting design adjustments

Q-Tip - Some Tips on Mock Ups - to be included on drawings and specifications.

Have them built by the same people who will do the work on the real building - otherwise, the entire effort is wasted;

Design mockups like any aspect of the design - select not only the location(s) where complexity of material and/or construction planes requires careful consideration, but also "typical" window, door and mechanical openings, which account for the highest proportion of envelope failures by far;

Note in specs. and at initial site meetings the requirement to accelerate fabrication and delivery of components such as sample windows, doors, mechanical exhausts, etc.

Test mock up's for performance "in place". Many components and their interfaces will fail first time 'round.

Repeat testing on later work product - check the last in as well as the first in, to confirm ongoing conformance. Even better if later tests are random.

Q-Tip - Thoughts About Sequencing - Designers know that some envelope components such as guardrails generally arrive on site late because of the need for field measurements to account for construction tolerances. There is another way to approach this potential delay. As a general statement, design can accommodate unknowns. In the case of the noted guardrails, slip joints at key locations would allow earlier fabrication. Any incremental cost increase would likely be more than balanced by quicker project completion.

☐ Establish a procedure to consider alternatives and substitutions

☐ Qualify materials for use or consideration

Refer to the Forms section of this Protocol for a Submittal Review form which also encompasses alternatives and substitutions.

Poorly researched and/or evaluated alternatives and substitutions in construction are one of the main causes of building envelope failure. The Submittal Review form in the Forms Section of the Manual is deliberately exhaustive and onerous. Everything requested on it is important to proper building envelope evaluation, and we strongly recommend refusing to approve proposals which are deficient in content or presentation.

Q-Tips - A Materials Hit List and a List of Material Hits - There's no time like the present to start a matrix of acceptable building envelope materials as they relate to compatible and incompatible neighbours. Unfortunately, some manufacturer claims about longevity and cohabitation are poorly researched. For example, we have tested self adhering adhesives (peel & stick) and sealant combinations which manufactures' literature indicates are compatible, only to find almost immediate failure. Conversely, some materials perform much better than advertised. Applier beware!

☐ Establish a formal means of accommodating Changes to the work

- i) Formal changes via Site Instructions and Change Orders
- ii) Informal changes via other authorized or unauthorized means.

The control of unauthorized changes is a key to preserving the integrity of the building envelope design.

Q-Tips - Four Kinds of Change - The standard construction industry contract describes 4 kinds of change to the Work : Site instructions; Change

Directives; Contemplated Change Orders; and Change Orders. Each is used depending on the circumstances, but there are only 4 circumstances. We use one master spread sheet form for all, simply crossing out the change types which do not apply. We are prompted to fill in data about location, reason, drawing/spec. references, costs, schedule changes, etc. Our rule is: if it's not published as one of these four, it doesn't exist. Most Contractors applaud that clarity and co-operate with it. There is no reason Builders could not adopt the same type of approach to Changes.

2.3.5. Commissioning

- ☐ Prepare Building Envelope Record Drawings (i.e., Final Design Drawings)

- i) for records by regulatory agencies
 - ii) for use by consumers.

Q-Tips - "AS INHABITED" DRAWINGS - Most Building Envelope Providers know what "as built" drawings are. However, most building owners and occupants do not, nor do they necessarily have access to as-built's. If as-built's are also annotated as to any variations in building envelope materials (e.g., peel & stick type 1 on the north face, type 2 on the south), then a set of these could become resource drawings for occupants for any post completion maintenance and repair work. These "as inhabited"s are especially useful when records of building envelope changes, leaks, etc. are noted right on the drawings. Sometimes patterns emerge which may help discover the source of apparent leakage or failure of the building envelope.

2.4. Design Input

Design input includes all of the factors and information which the Designer analyzes, then integrates into a design.

Document and review design input requirements for adequacy at planned design stages. The stages which are important as regards building envelope design include:

- ☐ identification of customer requirements

Polygon has an in-house quality assurance manual entitled "Quality is Free." Which captures a combination of technical and design requirements to achieve a consistent project quality. The addition, editing or deletion of pages requires three signatures, representing Design, Construction & marketing.

Some Designers (not enough) have checklists or other systematic means of extracting from clients the information and commitment they need in order to carry out design activity.

- ☐ expectations regarding durability and longevity

Our proposals include a questionnaire in which the client is asked about expected longevity, type of tenure and maintenance, etc.

- ☐ preferred building envelope materials and/or finishes

Polygon uses a "Working Drawing Checklist" describing specific expectations for specific drawings required by Polygon to construct a project. It is an amalgam of permitting, design, construction and marketing findings.

- ☐ receipt of customer drawings and technical documentation
- ☐ customer designs and other requirements may affect building envelope integrity

Where customer requirements may affect envelope integrity, the situation should be reviewed with the customer and if the resolution is not satisfactory, this should be noted on the appropriate BPG variance form.

Also known as "C.Y.A." if the client disagrees.

Review of related standards and regulatory requirements

- ☐ materials and forms mandated by planning authorities, such as in design guidelines

NOTE: Elsewhere in this Quality Manual the concept of analyzing variations from BPG details is introduced. It is perfectly reasonable to include the requirements of planning authorities as a reason for varying from BPG details.

- ☐ The BPG and Part 5 of the VBBL/BCBC

Refer to the Forms Section of this Protocol for a building envelope design review meeting agenda template.

- ☐ environmental conditions

i) particular exposures to the elements

- ☐ experience gained during development of previous similar designs

This is where the value of records comes into play.

- ☐ Design input activities so as to resolve incomplete, conflicting and/or unclear requirements.

Design input data may be summarized in the form of The Building Story, discussed in a previous Q-Tip.

As a minimum building envelope design control measure, each Designer should describe their design in terms of these building envelope considerations - the 4 D's:

2.4.1. Deflection

- ☐ The removal of moisture from the envelope before it impacts on more vulnerable surfaces;

2.4.2. Drainage

- ☐ The removal of moisture from within the building envelope
 - ☐ Includes removal from within the envelope, on the conservative assumption there will always be leakage over time

2.4.3. Drying

- ☐ Means to dry out the building envelope, both on outside surfaces and within assemblies

2.4.4. Durability

- ☐ Determination of component and assembly longevity, plus maintenance requirements to preserve and extend service life.

2.5. Design Output

Design output includes all of the materials which describe a Project design, such as drawings, specifications, schedules, shop drawings, etc.

Design output criteria to match design input requirements as reflected in:

- ☐ design drawings for tender and construction
- ☐ Technical Specifications
- ☐ Shop Drawings⁵
- ☐ Format design output documents to facilitate the communication of building envelope information to Builders, Suppliers and Installers.

This Quality Manual contains a number of suggestions regarding communication of this information.

2.6. Design Review

- ☐ Include a schedule for design reviews at designated stages of the project. Conduct these activities at defined intervals.

Building envelope consultants typically contract for reviews at specific stages, such as schematic design and tender, but this information needs to be communicated to the balance of the design team.

Q-Tip - Design Review Meeting(s) - Most (but not all) designs evolve in part through a series of coordination meetings or design review meetings, where Designers, the Owner and sometimes the Builder, review approaches to design and construction as well as details. These should be structured to include the following building envelope content:

- ☐ ***Concept Review*** - Review of available building envelope concepts for the project; selection of envelope concept(s) for use on project; identification of key details and material selections;
- ☐ ***Schematic Design/ Design development review(s)*** - more detailed review of design to ascertain evolving design is following concepts; identification of additional detailing requirements and challenges; evaluation of general conformance to Part 5 of the Building Code.
- ☐ ***Tender Review*** - During the pricing phase, evaluate proposed alternates and substitutes from a building envelope perspective;
- ☐ ***"For Construction" review*** - last chance to make refinements before construction starts.
- ☐ Provide or analyze design review during Coordination Meetings attended by Quality Management Representatives and Designers of all parties affected by the design process.
 - Q-Tip - Keynote Design Review*** - We have developed a CAD based system of building envelope keynotes which we use effectively in design review. Each keynote has a unique number keyed to the 16 division master specifications format. A selection of notes is attached to each reviewed drawing, and new notes developed as appropriate. The custom list of notes for each design review is affixed to the drawings, then returned to the Designers. An added bonus - each time we create a keynote, it becomes a system wide note available for immediate reuse elsewhere. Thus as our professional body of knowledge expands it is captured and available to all.
- ☐ Maintain Coordination Meetings Minutes and an "outstanding items" list to be carried forward until items are resolved.

Polygon has a simple but effective "new items/previous items" approach to issues resolution which works.

2.7. Design Verification - SIGN-OFF

Obtain design Verification (a.k.a. Sign-off) at various design stages defined in the Design Plan, including:

- ☐ for each detail, when evaluated against the BPG details;
- ☐ prior to issuance of documents for each Design Review Stage
- ☐ prior of issuance of documents for permit application, for tender and for construction
- ☐ prior to issuance of documents for "as built", "as inhabited" or record purposes.

Q-Tips - DESIGN VERIFICATION "in the margins" - The prevalence of computer aided design and the resulting continuity of design documentation from concept design through record drawings affords an opportunity to record design verifications. Some firms print long, narrow charts along binding edges of drawings, allowing the design verifier to affix initials at the appropriate phase. The number of opportunities is only limited by the length of the margin and the size of the review budget. The comments immediately above suggest a minimum of nine occasions: BPG/ at least 1 internal design review/ planning permission/ building permission/ tender/ construction/ as-built/ as-inhabited/ record. The Client should sign off at the BPG/planning/building/tender/construction phases as a minimum.

2.8. Design Validation - MOCKUPS & SUBMITTALS

Use Design Validation to complement Design Verification activities (as described above) aiming at confirmation that the final building envelope meets specifications.

The Contractor is generally responsible for design validation, which is performed during construction by:

- ☐ Site evaluation with the customer and designer, e.g., mockups;
Refer to Chapter 4 for a detailed discussion of mockups.
- ☐ Submittals to the designer, including shop drawings, samples, manufacturers' literature, etc.
- ☐ Maintain records of design validation.

Q-Tip - The Caterpillar approach to Submittal review - It is too easy to lose track of Submittal status. One approach which appears to work involves establishing a list of all required submittals at the outset of a project, in a table form such as this (sample only - incomplete):

Spec section/ item	Mock up req'd	Type of submittal (shaded not req'd)			
		Manu. literature ⁱⁱⁱ	Shop drawing	Test data	Sample ^{iv}
01300 Construction schedule					
02074 geotextile					
03300 concrete mix design					
03400 precast concrete					
03600 grout					

ⁱⁱⁱ Manufacturers literature indicating proposed product(s), performance standards, application directions and method(s) of fastening to/through substrate(s)

^{iv} sample means each unit type, together with name of unit, supplier, available tech. data.

04050 brick ties					
04050 weepholes					
04200 masonry units					
04210 clay masonry units					

It becomes a simple matter to track the status of submittals with comments in the table. But the key element of the list is that we issue it with each submittal review, so all parties are constantly updated as to our understanding of all submittal status.

2.9. Design Changes⁶

- ☐ Identify, describe, review and approve design changes and modifications introduced during the design development process.

Include with changes to design documentation and data, where applicable:

- ☐ clear identification of changes
- ☐ appropriate endorsements and permits
- ☐ clear explanation of reasons for changes

Q-Tip - "Wha' happened?" - Too often changes occur which have negative repercussions, yet there is no "trail" describing why the change(s) occurred. It is better to have participated in a change, perhaps in genuine error, than to have acquiesced to a change with no valid reason.

2.10. Design Control: Records⁷

- ☐ Maintain the following design records :

	Name	Responsibility
1/	Quality Plan	QMR
2/	Design Drawings and Data	Designer
3/	Project Files	Designer
4/	Designer Meeting Minutes	Designer

2.11. Document and Data Control: Responsibility

- ☐ Each person charged below with responsibility for document or data control shall ensure that each document provided by it, including supplies and fabricated elements, includes contact information for the associated Quality Management Representative (QMR).

It is essential that any person with a quality assurance mandate be able to contact any other document/data provider .

Designers: The Quality Management Representative (QMR) for each Designer shall be responsible for all controlled documents pertaining to

- ☐ best practices and any variations or modifications thereto
- ☐ quality control during the design process
- ☐ building envelope quality verification during the permitting, construction and commissioning phases
- ☐ quality assurance verification at project completion.

Builders : The Quality Management Representative (QMR) on site for each Builder shall be responsible for all controlled documents pertaining to

- ☐ best practices implementation and any associated difficulties

Basically, the Builder QMR identifies situations where best practices do not appear possible, for review by Designers.

- ☐ quality control during the construction process including issuance of work instructions
- ☐ building envelope quality verification during the trade permitting, construction and commissioning phases

This will involve the supply of a variety of warranties and guarantees confirming the quality of specified products and installations,

- ☐ quality assurance verification at project completion.

This will include completion of identified deficiencies

- ☐ quality assurance warranty

This currently involves the one year warranty inspection and remediation of discovered deficiencies. Warranty requirements are under discussion at the industry/government levels and may change in the near future.

Suppliers: The Quality Management Representative (QMR) for each Supplier shall be responsible for all controlled documents pertaining to

- ☐ best practices, including interfaces between supplied materials and materials supplied by others
- ☐ quality control of the fabrication of the supplied materials
- ☐ selection and delivery of supplied materials, especially that supplied materials match purchase orders and construction documents
- ☐ supply of sufficient information with delivered materials to provide for building envelope quality verification for supplied materials

This typically includes application instructions, storage instructions, warnings about handling and installation, etc.

- ☐ quality assurance
- ☐ quality assurance warranty

This currently involves various warranty terms and conditions. Warranty requirements are under discussion at the industry/government levels and may change in the near future.

Installers: The Quality Management Representative (QMR) for each Installer shall be responsible for all controlled documents pertaining to

- ☐ best practices, both traditional to a Trade and as recommended by the Best Practices Guide

The most critical identified deficiencies in this area relate to sequencing of work and appropriate provision for penetrations and similar envelope disruptions.

- ☐ quality control of installations
- ☐ building envelope quality verification as related to a specific installation
- ☐ quality assurance
- ☐ quality assurance warranty

This currently involves the one year warranty inspection and remediation of discovered deficiencies. Warranty requirements are under discussion at the industry/government levels and may change in the near future.

2.12. Document and Data Control: Procedure

Follow the general guidelines below for documents :

- ☐ A Controlled Documents Log shall be established and maintained.

Refer to the Forms Section of the Quality Manual for a suggested format for this Log.

- ☐ All copies of controlled documents shall be identified with a "Controlled Document" stamp or similar identification

Refer to the Forms Section of the Quality Manual for suggested wording of such a stamp.

- ☐ Only authorized and the most current versions of the relevant controlled documents and data shall be used

"Authorized" identification should be as established between the QMR's for the various Building Envelope Providers to a Project.

Use the Controlled Documents Log to determine the most current version of a document.

- ☐ Invalid or obsolete documents shall be removed from all points of use or clearly identified.

It may be necessary to retain certain obsolete documents for contract record purposes and similar.

2.13. Controlled documents and data: Approval and Issue

The Building Envelope Provider policy regarding controlled documents is as follows:

- ☐ Documents shall be free from unauthorized notations and changes. Distribution of the controlled documents and/or data shall be documented in the Document Distribution portion of the Log.

In some instances and project scales, all Log contents may perhaps be registered on the Contract documents. Many Designers already use "Document Issue" and "Revision" columns to incorporate some control measures.

Q-Tip - HIGHLIGHTING REVISIONS - There is a long-standing practice of using tiny triangles to indicate areas of drawings which have been amended. Finding these triangles and discerning the extend of revisions is a frustrating process and if the indications are too obscure, important revision information

will be missed. A superior practice is to "cloud" the revised area with a hand-drawn cloud or bubble, to which the revision triangle is attached. Most CAD systems allow this to be done electronically and using layering techniques, successive revisions may be temporarily hidden so that only the current issue of revisions is visibly highlighted.. As a bonus, these more obvious revision indications make the preparation of Project records documents much easier in future, as all "layers" of revisions may be simultaneously made visible.

- ☐ Status/issue of the controlled documents/data shall be always properly identified.

See Q-Tip above

- ☐ Original document (original copy) records shall be maintained by the originator.

See Q-Tip above.

2.14. Controlled documents and data - Changes and Modifications

See also Q-Tip above

- ☐ Revised document/data shall be reviewed and endorsed by the authorized personnel responsible for issue and control of the original document.

This suggests the Log and/or the actual document should have a location for the issuer's "approved for issue" initials.

Where the person responsible for the original document is not the QMR, then the QMR should also initial "approved for issue" .

- ☐ Information regarding document/data nature of change, issue and date of issue shall be provided.

See the Log in the Forms Section of this Manual.

- ☐ Nature of the change of the controlled document shall be identified.

We have found no problem (space permitting) with the idea of affixing to the "cloud" surrounding revisions a note describing the nature/reasons for a change.

2.15. Document and Data Control - Records

- ☐ Controlled documents should be properly identified and authorized.
- ☐ All changes to controlled documents and data should be documented and recorded.
- ☐ Current issues of controlled documents shall be available at all locations where operations essential to the effective functioning of the quality system are performed.

Traditional hierarchical organizations often have a list of authorized signatures required on a document. These authorization lists are usually organized by hierarchy so that each successive reviewer can see that the more junior reviewer has authorized issue. Authority may carry monetary limits, permitting document issue with a reduced "sign off" requirement, depending on associated costs.

- ☐ Controlled documents and data should be legible, dated, clean, readily identifiable to a specific project and to the relevant stages of the building envelope construction process, and maintained in an orderly manner. A method for obsolete documents identification and/or disposal shall be defined and followed. This applies to both hard copy and electronic controlled documents and data.

Quality Manual users may wish to consult relevant legal consultants for advice here, and/or professional and trade organizations.

- ☐ The following records of Document and Data Control, either manual or electronic, shall be maintained:

Name	Responsibility
Controlled Documents Log	QM Representative
Document Distribution Log	QM Representative
Controlled Document Stamp	QM Representative

2.17. Organizational Interfaces

- ☐ The Principal Design Consultants have allocated responsibility for the coordination of professional services provided by all Designers to a Coordinating Registered Professional (CRP). The CRP may or may not be the Quality Management Representative (QMR) for the Principal Design Consultants.
- ☐ Each of the Designers and Builders have allocated responsibility for design and product development to qualified and competent personnel.
- ☐ Each Building Envelope Provider has nominated a QMR for the project.

Specific responsibilities are defined in personnel job descriptions and include:

- ☐ evaluating and documenting the application of Best Practices to a specific design
 - ☐ liaising with the customer in design-related matters
 - ☐ developing and controlling drawings and data
 - ☐ obtaining design verification (Sign-off) by the customer
 - ☐ preparing documentation for regulatory approvals, tendering and construction.
-
- ☐ The responsibility, authority and interrelation of personnel contributing to the design control process are reflected in the Design Control portion of the Project Quality Plan, which is reproduced below and footnoted with fill-in information.

The DRM may be used by anyone with any design responsibility, whether for tender documents, shop drawings, specialized consultants' drawings., etc.

¹ Each section of the Quality Manual will have an highlighted/ boxed introduction, designed to explain to the reader/ user the function of the specific section.

² © COPYRIGHT 1998 Pro Pacific Architecture Limited.

³ Comments by Joe Tsiburek at a lecture in Vancouver to BCBEC, 1997.

⁴ Refer to Section 4.1 of the Quality Manual for information regarding the Quality Plan.

⁵ Where this Section is adapted for Contractor/ subcontractor/ supplier use, the Design Responsibility matrix and similar documents would be modified to reflect the viewpoint and requirements of the Designers working for these companies.

⁶ This text needs more work.

⁷ The Manual may eventually specify more detailed records or records customized by the individual user. These are the bare minimum per ISO

Chapter 3. BUYING QUALITY.....	1
INTRODUCTION.....	1
Main headings are located at Level 1 and numbered 1.1 and on.....	5
Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.....	5
3.1. Purchasing.....	5
3.1.1. Purchasing: Purpose and Definition.....	5
3.1.2. Purchasing: Responsibility.....	6
3.1.3. Purchasing: Supplier Assessment.....	6
3.1.4. Purchasing: Data.....	7
3.1.5. Purchasing: Verification of Purchased Product.....	7
3.1.6. Purchasing: Records.....	9
3.2. Control of Customer-supplied Product.....	9
3.2.1. Control of Customer-supplied Product: Definition and Purpose.....	9
3.2.2. Customer-supplied Product: Guidelines.....	9
3.2.3. Customer-supplied Product: Records.....	10
□ Product Identification and Traceability.....	10
3.3.1. Product Identification and Traceability: Purpose.....	10
3.3.2. Product Identification and Traceability: Responsibility.....	11
3.3.3. Product Identification and Traceability: Guidelines.....	12
3.3.4. Product Identification and Traceability: Records.....	12

Chapter 3.

BUYING QUALITY

INTRODUCTION

Contrary to popular myth, quality is not free, and the first cost of assured quality goods or services performed by a reliable subcontractor may appear to be higher than the best deal available on the open marketplace. However, good quality often costs less. The bonus comes in the form of the reduced overall costs of completed work due to increased productivity and reduced losses resulting from the minimal interim rework and warranty repairs.

Purposes of this Chapter

Materials and components purchased by a Contractor affect the quality of the building envelope. Also, the quality of subcontracted services required for the completion of the building envelope will have a direct influence on the durability of the finished structure. **This chapter addresses how to inject quality considerations into the purchasing of materials, systems and services alike.**

A Building Envelope Provider must assure himself that **Customer-supplied product is suitable** for its purpose/use and that the outcome of services subcontracted by the Customer to another Provider fulfills Customer requirements and expectations. **This chapter identifies methods of assessing customer-supplied products**

Many deficiencies in building construction arise from **unwarranted or in planned alternatives and substitutions during construction**. This chapter introduces the importance of identifying and tracing products and services in the building

envelope, both to reduce errors in initial construction and make traceability of problems easier, hence improve the ability to repair latent defects.

What is Customer supplied product? In some cases specific components of a building envelope may be supplied by the Customer for incorporation into the final product. Occasionally the Customer (Investor, General Contractor, etc.) may also subcontract specific parts of work involved in the building envelope construction process beyond the scope of an agreement with the Builder, but the Builder remains directly responsible for the quality of the completed work.

What is the Main Purpose of Product Identification and Traceability ? - From the time of goods receipt to the point of their usage, the identity of materials, components and assemblies etc., should be maintained in order to prevent accidental or inappropriate use. All too frequently purchased products or components are "lost" at the building site or within the system through lack of proper identification. Sometimes this results in inappropriate substitutions.

Key Concepts

- ☐ The broad statement that "everything affects quality" gains particular meaning when related to the quality of purchased goods and services.
- ☐ A properly defined quality system shall also consider auxiliary services employed by the Builder such as transportation, communication,
- ☐ Improved quality in auxiliary services will translate into a better balance between cost and quality.
- ☐ In general there is no difference between the role of the Customer and the role of the Suppliers & installers to the Builder. In both cases quality of the received product should be assured and verified in line with contract requirements and guidelines provide in the Quality Manual.

Quality Manual Approach

- ☐ a defined purchase order procedure
- ☐ a method of sourcing of purchased goods and services from qualified supplier/subcontractors;
- ☐ agreed quality verification criteria
- ☐ provisions for settlement of quality disputes;
- ☐ control of purchasing records

Properly structured quality assurance provisions in purchasing should be commensurate with the needs and nature of the Builder's, Suppliers' and Installers' businesses and should avoid unnecessary costs. In certain cases, formal quality assurance systems may be required of the Suppliers or Installers. This may include periodic assessment by the Builder or Customer's Quality Management Representative.

In line with generally accepted quality practices the Building Envelope Provider shall verify the quality of Customer-supplied product provided for incorporation into the building envelope. The Building Envelope Provider also remains responsible for storage and interim maintenance of product provided by the Customer (Investor or General Contractor). If the quality of customer-provided product is found not to conform to specified requirements or if

product is lost, damaged or is otherwise unsuitable for use, this shall be recorded and reported to the Customer.

The Building Envelope Provider may choose from the following arrangements for the Customer-supplied product quality verification purposes:

- a) *Specify, document and implement unique methods for Customer-supplied product verification*
- b) *use the methodology defined in this Quality Manual to verify the quality of any purchased*
- c) *use any combination of the above*

Whenever applicable, the Building Envelope Provider shall establish and document methods for identification and traceability of materials and/or components during all stages of building envelope construction, assembly and related installation work. The Building Envelope Provider shall describe both the manner in which materials, products (including provided services) or prefabricated components are identified. The method employed to maintain batch (product, service) identity right through until the final quality has to be also determined.

The extent of identification and traceability shall depend on requirements defined by the Customer and regulations applicable to the building envelope. Additionally utilized methods of building envelope identification and traceability shall address needs of specific building site dictated by site arrangement, sequence of building envelope assembly, etc. In some circumstances unique identification and traceable records of individual product or batches may be necessary.

Specifically, whenever purchased products or prefabricated building envelope components are released for construction or assembly purposes, their identification shall be recorded in order to permit rework or replacement in the event of nonconformance to specified requirements.

Also in cases when corrective or preventive action was introduced in-process, it may be advantageous to document the point at which this action was commenced in order to assist in the evaluation of corrective action effectiveness.

Values of this Section

Close working relationships established between the Builder, Suppliers and Installers creates a more desirable work environment in which continual quality improvement activities can be maintained and quality disputes avoided or settled quickly.

Adherence to these guidelines is in the Building Envelope Provider's vital interest, as the verification of supplied product quality by the Building Envelope Provider does not in any way absolve the Customer of the responsibility to provide acceptable product. A clear understanding should be developed between the Building Envelope Provider and the Customer on quality assurance for which the Customer is responsible. This may be reflected in proper clauses constituting integral part of the contractual agreement.

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3.1. Purchasing

3.1.1. Purchasing: Purpose and Definition

The guidelines contained in this Section of the Quality Manual are intended to ensure that:

- goods and services purchased by a Contractor conform to specified quality requirements
- purchasing activities are conducted according to documented procedures

This Procedure applies to:

- purchased materials,
- components,
- construction and inspection equipment,
- sub-contracted services and
- consumables (paints, resins, glues, fillers, oils, greases, etc.)

all the above as required for construction of the building envelope and for related quality verification purposes.

3.1.2. Purchasing: Responsibility

- ☐ The Builder, Supplier and/or Installer personnel with responsibility for procurement of goods and services required for construction of the building envelope ensure compliance with all relevant procedures related to purchasing activities.

This is typically the Site Superintendent. Many sophisticated Builders still afford their site superintendents great latitude in material/ system selection and procurement. The downside of this occurs when the site superintendent assumes that authority allows convenient substitutions "on the fly". Even this may be acceptable if there is a procedure for evaluating "on the fly" proposals for substitution.

- ☐ The Quality Management Representative (QMR) is responsible for verification of the quality of the purchased product.

This is typically the Project Manager or in some cases, the Purchasing Manager

Unless otherwise advised, the Site Superintendent is generally responsible for documenting purchased goods and services on the Purchase Order, and in particular for:

(Although the evolution of the Quality Assurance Protocol was, in part, a response to the socratic question, "Does the success of a project really depend entirely on the character of the site superintendent?", it is clear at this stage of industry evolution on the west coast that the success or failure of construction activities remains largely in the hands of that individual).

- ☐ complete and accurate description or specification of the ordered product

It's a constant fight to obtain reasonable technical data to back up a request for substitution.

- ☐ relevant technical information; including product performance parameters, quality and shipping/handling requirements

The Submittal Review form located in the Forms section of this Protocol encompasses a submittal in support of a tender, and includes typical information valuable in assessing building envelope suitability. There is no reason a site superintendent should not assemble his/her own submittal data, which can be efficiently presented to the Building Envelope Reviewer in the event of a proposed "on the fly" substitution.

A sample Purchase Order incorporating Quality management language is included in the Forms Section of this Protocol

- ☐ identification of the Supplier/Installer's Quality Management Representative.

3.1.3. Purchasing: Supplier Assessment

- ☐ Perform the assessment of the Supplier/Installer suitability using the Builder personnel with the responsibility for procurement of required goods and services.

Make sure the folks buying the goods can work with the folks selling the goods.

- ☐ Complete Supplier Assessment through an analysis of information regarding the Supplier/Installer profile including, where applicable, data regarding past performance.

Note: Whenever considered advantageous, the Builder may visit the Supplier/Installer's premises or other installations to verify the integrity of the received information.

True ISO 9001 certification would require some of the verifications to be in writing, e.g., proof of CSA certification.

- ☐ Distribute a Supplier Assessment Questionnaire as follows:
 - to the new/potential Supplier/Installers prior to any formal commitment (submission of quotation or tender) to the Customer. An exception to this condition are the Suppliers and Installers generally considered suitable for business with the Builder. This "general suitability for business" status applies to the Supplier/Installer engaged by the Builder for the first time to perform minor construction or installation work or to provide a service which is not critical to the quality of the building envelope (i.e., equipment rental companies, catering, communication, etc).
 - to all approved Supplier/Installers who maintain ongoing continuity of business with the Builder every 3 years.
- ☐ The Builder personnel with responsibility for procurement. Shall maintain an Approved Suppliers List

Q-Tip-- A List of Greatest Hits - In our experience there is still reluctance by Suppliers and Installers to make any effort beyond predatory pricing to secure market share with Builders. Where we have a well developed relationship with a Builder, he/she may simply advise proponents of alternatives/substitutions to give us the information we request to evaluate their proposals. We have started a list of pre-approved materials/systems, for which we keep necessary backup data. We neither solicit nor accept any remuneration for including a material/ system on our list. A reputable Builder will do the same, however there should be a cachet attached to being included on and remaining on a pre-approved list.

3.1.4. Purchasing: Data

- ☐ Verify and endorse the adequacy of requirements related to the purchased goods and services by ensuring the Purchase Order contains, whenever applicable:
 - Precise identification of the product (name or description, type, grade, class, style, applicable standard, etc.)
 - Clear reference to applicable drawings and specifications
 - Required packaging, handling, storage and shipping instructions
 - Other relevant information pertaining to quality of purchased goods and/or services

The Submittal Review form located in the Forms section of this Protocol encompasses a submittal in support of a tender, and includes typical information valuable in assessing building envelope suitability.

3.1.5. Purchasing: Verification of Purchased Product

- ☐ Evaluate the quality of purchased goods or services upon receipt of purchased goods or at any stage of delivery of subcontracted services, as considered practical.

Verification methods employed by the Builder may vary depending on the importance of the purchased product, Supplier/Installer quality performance history and the adequacy of the quality system operated by the Supplier/Installer.

- ☐ Whenever applicable, request a Certificate of Compliance, Guarantee or Warranty for goods and/or services which are considered critical to the quality of the finished wood frame building envelope.

Critical goods or services are those which may jeopardize the quality, durability, reliability or safety of the finished building or otherwise seriously affect customer satisfaction. Purchased goods or services which may affect compliance required by appropriate regulations shall always be considered critical.

- ☐ Whenever specifically agreed the Builder shall make appropriate arrangement with the Supplier to allow for inspection of the purchased goods at the Supplier's facility prior to delivery to the building site.

This verification may be performed by the Builder or by the Customer Quality Management Representative and shall not absolve the Supplier/Installer from responsibility for the quality of purchased goods. Disregarding the circumstances of verification of purchased goods or services, the Builder shall also reserve the right to reject non-conforming product or to refuse to accept substandard services.

3.1.6. Purchasing: Records

- ☐ Maintain the following records, either manual or electronic:

Item Name	Responsibility
1./Purchase Orders	Site Superintendent or other personnel nominated by the Builder
2./Certificates of Conformance	Quality Management Representative (QMR) / Site Superintendent
3./Supplier Assessment Questionnaire	QMR or other personnel nominated by the Builder
4./Approved Suppliers List	Site Superintendent or other personnel nominated by the Builder
5./Supplier Files	Builder personnel with responsibility for procurement

3.2. Control of Customer-supplied Product

3.2.1. Control of Customer-supplied Product: Definition and Purpose

Customer-supplied product is a product owned by the Customer and supplied under contractual agreement for incorporation in the building envelope by the Builder.

3.2.2. Customer-supplied Product: Guidelines

- ☐ For simplicity and uniformity of the Quality System, the Building Envelope Provider should elect that there will be no distinction between Customer-supplied products or products acquired otherwise by the Builder.

For **all** received products, regardless of their origin or commercial arrangements, the Building Envelope Provider shall take appropriate steps to assure itself and its Customer that:

- ☐ the received product is suitable for its purpose, and
☐ its condition and quality is verified and maintained.

This policy applies to all goods and services provided by the Customer for incorporation in the finished building envelope.

assessment by the Building Envelope Reviewer. Whenever specified in contractual agreements, identification and traceability requirements may extend to the warranty provided for the building envelope by the Building Envelope Provider.

- ☐ Whenever applicable, building envelope components shall be identified, including procured materials and services, sub-contracted work, design development stages, building envelope construction and verification, commissioning, and all other related activities defined in the contracted project scope.

A surprising number of materials are still delivered to construction sites without any identification, or with questionable identification. What is that black clad insulation, anyway?

We give preference to materials which are well labelled and come with application/ installation instructions.

This identification shall be maintained by the Building Envelope Provider in order to:

- allow for proper monitoring of building progress
 - ensure traceability of related work, purchased goods, equipment and services
 - ensure adequate control of quality and quality-related activities
- ☐ Whenever contractually agreed, specific customer requirements regarding project identification, traceability of performed work and delivered services are to be accommodated.

3.3.2. Product Identification and Traceability: Responsibility

- ☐ The Site Superintendent is responsible for coordination and progress of construction work
- ☐ The Site Superintendent shall set up the guidance for building envelope identification and traceability.

The Site Superintendent shall ensure these guidelines are followed.

- ☐ Customer-supplied product shall be, therefore:
 - inspected upon receipt or at service completion stage.
 - stored and/or maintained in a way which preserves quality of the supplied material or protects acceptable status of delivered services
 - reported to the Customer if it is considered substandard or if supplied product is lost, damaged or found otherwise unsuitable for use.

- ☐ Results of these activities shall be documented

Verification of quality and quantity for all products supplied to the Building Envelope Provider, including Customer-supplied goods and services, shall follow the guidelines of all related procedures documented in this Manual.

Applicable Sections of Quality Manual:

- ☐ Contract Review
- ☐ Purchasing
- ☐ Product Identification and Traceability
- ☐ Inspection and Testing
- ☐ Inspection and Test Status
- ☐ Control of Non-conforming Product
- ☐ Corrective/Preventive Action
- ☐ Handling, Storage, Packaging, Preservation and Shipping
- ☐ Control of Quality Records

3.2.3. Customer-supplied Product: Records

- ☐ Maintain relevant records, as indicated in the above procedures.

☐ **Product Identification and Traceability**

Q-Tip—No Name Brands – There are still a surprising number of Suppliers whose products have little or no identification, when identification is clearly possible. A recent example for us concerned a rigid roofing installation manufactured by a major North American company, whose only identification was on shipping bags, which were almost immediately removed on site. The individual boards had no identification whatsoever, whereas competitive products did. We queried the manufacturer, who advised they had no interest in improving their communication efforts, notwithstanding we pointed out all of the potential misuses of their product which could arise from lack of labeling. **That product no longer finds its way onto sites in which we have involvement. Sometimes, the only solution to intransigence is to find new suppliers.**

3.3.1. Product Identification and Traceability: Purpose

The purpose of this procedure is to describe methods selected by the Building Envelope Provider to identify and trace components of the building envelope.

This procedure applies to the completed building envelope and its individual components and to all stages of building envelope construction, assembly and

- ☐ All Building Envelope Provider personnel (within respective areas of responsibility and authority) are responsible to ensure compliance with building envelope identification and traceability guidelines as specified in this Manual and applicable instructions.

3.3.3. Product Identification and Traceability: Guidelines

The Building Envelope Provider shall ensure that building envelope identification and traceability methods:

- reflect guidelines (if any) provided in project-related documentation
- ensure positive identification and traceability of building envelope components

This means labels which remain visible throughout the construction process.

- quote Project Number or other agreed identification on related documents, i.e. Purchase Orders, certificates, Invoices, check sheets, progress reports, submittals, etc.
- provide easy access to identification marking
- maintain legibility over required period of time (taking under consideration wear, deterioration, environment, etc.)

- ☐ Methods of building envelope components identification shall suit Customer requirements, address specific needs of the building site, including building site logistics, environment and specific building construction concerns.

In other words, ask the personnel on site how they want product labelled for their ease of use.

3.3.4. Product Identification and Traceability: Records

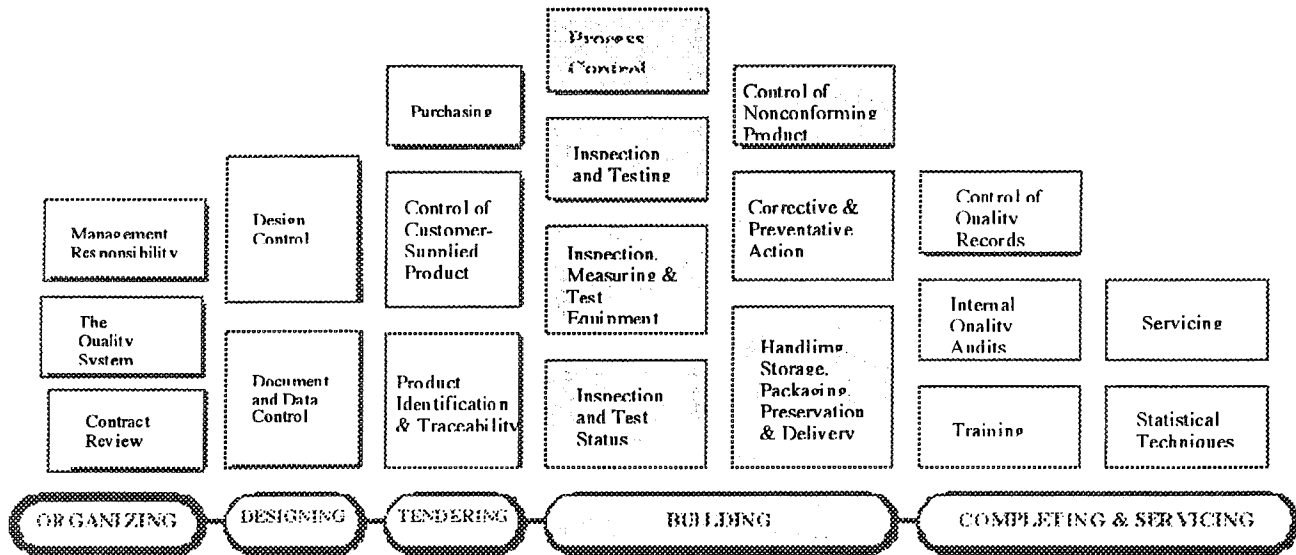
- ☐ Building site documentation and records shall be maintained and the identification with Project Number shall reflect established relationships between the Project, its individual stages and related documentation of the building envelope.

Chapter 4	BUILDING QUALITY	3
Main headings are located at Level 1 and numbered 1.1 and on		4
Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps		4
Introduction		4
4.1. Process Control		6
4.1.1 General		6
4.1.2 Definitions		7
4.1.3 Responsibility		8
4.3.4 Process Control Procedures		9
4.1.5 Process Control: Records		16
4.2. Inspection and Testing		17
4.2.1 Inspection and Testing: General		17
4.3. Receiving Inspection And Testing		17
4.3.1 Receiving Inspection and Testing: Introduction		17
4.3.2 Receiving Inspection: Responsibility		18
4.3.3 Receiving Inspection: "Critical" Product		18
4.3.5 Receiving Inspection: Inspection Level		19
4.3.5 Receiving Inspection: Procedure		19
4.3.6 Receiving Inspection: Records		20
4.4. In-Process Inspection and Testing		20
4.4.1 In-process Inspection and Testing: Purpose		22
4.4.2 In-process Inspection and Testing: Responsibility and Procedure		22
4.4.3 In-process Inspection and Testing: Records		26
4.5. Final Inspection And Testing		27
4.5.1 Final Inspection and Testing: Purpose		29
4.5.2 Final Inspection and Testing: Responsibility and Procedure		29
4.5.3 Final Inspection and Testing: Records		30
4.6. Inspection, Measuring and Test Equipment		30
4.6.1 Inspection, Measuring And test Equipment: Introduction		30
4.6.2 Inspection Equipment: Responsibility		31
4.6.3 Inspection Equipment: Records		31
4.7. Inspection and Test Status		32
4.7.1 Inspection and Test Status: Introduction		32
4.7.2 Inspection Status Identification: Responsibility		32
4.7.3 Inspection Status Identification: Procedure		32
4.7.4 Inspection and Test Status: Records		33
4.8. Control of Nonconforming Product		33
4.8.1 Control of Nonconforming Product: Introduction		33
4.8.2 Control of Non-conforming Product: Definition and Purpose		34
4.8.3 Control of Non-conforming Product: Responsibility		34
4.8.4 Control of Non-conforming Product: Procedure		34
4.8.5 Control of Non-conforming Product: Records		35
4.9. Corrective and Preventative Action		35
4.9.1 Corrective and Preventive Action: Introduction		35
4.9.2 Corrective and Preventative Action: Quality Problem Definition		37
4.9.3 Corrective and Preventative Action: Reporting		37
4.9.4 Corrective and Preventative Action: Investigation		38
4.9.5 Corrective and Preventative Action: Implementation		38
4.9.6 Corrective and Preventative Action: Confirmation		38
4.9.7 Corrective and Preventative Action: Records		39
4.10. Handling, Storage, Packaging, Preservation and Delivery		39
4.10.1 Handling, Storage, Packaging, Preservation and Delivery: Introduction		39
4.10.2 Responsibility		40
4.10.3 Handling		40
4.10.4 Storage		41

4.10.5 Packaging	41
4.110.7 Preservation	42
4.10.6 Delivery.....	42
4.10.7 Handling, Storage, Packaging, Preservation and Delivery: Records.....	42

Chapter 4

BUILDING QUALITY



THE QUALITY ASSURANCE PYRAMID

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Introduction

*Not surprisingly, this chapter on Building Quality is the largest of the five.
After all, all the other aspects of Quality by Design are meaningless if it can't
be built right!*

Control of the building envelope construction process should ensure that related operations proceed under controlled conditions, in an appropriate manner and sequence. Controlled conditions include appropriate controls for materials, construction equipment, personnel, supplies, utilities and environments.

This rather complex requirement means that:

- quality of materials used for construction is verified and conforms to specified requirements
- construction equipment is in good working order and performs up to the Contractor's expectations
- personnel employed for building envelope construction are adequately trained and/or experienced
- required supplies are delivered on time, in requested quantity and in good condition
- operations are performed in line with applicable work instructions, trade practices and regulations
- construction work is only conducted in suitable environmental conditions

The ISO Standard sets out 7 sections which naturally fall under the building umbrella:

1. Process Control

- Building envelope Process Control means "**building the building envelope.**" It encompasses the control of all activities, operations and processes necessary to erect the building envelope. The Building Envelope is defined as "**the horizontal, vertical and inclined assemblies which intercede between the interior and external environments**". For simplicity and for the sole purpose of this Quality Manual, any combination of the above operations and processes we will call "construction" or "construction process". For the same reason we will also refer to the applicable activities, operations and processes as "operations".

2. Inspection and Testing

Inspection and testing at the building site cover three areas that have a direct influence on the quality of the finished building, its overall quality, proper functioning and expected durability.

These areas are:

- a) Receiving Inspection which applies to the quality of purchased goods and services, including circumstances when goods or services are arranged and supplied to the site directly by the customer.
- b) In-process Inspection which applies to the work performed on site by the Builder, Suppliers and/or Installers
- c) Final Inspection is applicable to the finished product, or a defined part thereof, i.e. to a specific stage of the project such as concrete work, electrical, framing, cladding, etc.

NOTE: The word inspection, where used in this Section, may be taken to mean "review".

3. Inspection, Measuring and Test Equipment

A structural engineer who has recently become ISO 9001 certified confided in me that his ISO "coach" at one point suggested this meant he should calibrate his office's tape measures. The Engineer pointed out that whether a rebar is 18" or 19" long is seldom a matter for quality concern, and the requirement was quietly deleted.

Nonetheless, there is equipment used in determining building envelope adequacy which requires calibration. This Manual recommends calibration by third party specialists.

4. Inspection and Test Status

The status of inspections of a completed building envelope, building envelope components and or related purchased products should be identified at all stages of construction or storage of the components on building site.

5. Control of Nonconforming Product

The Builder is expected to establish and maintain an effective, documented system for control of nonconforming building envelope.

Procedures should exist for dealing with any non-conforming building envelope, however and whenever identified. The procedures should cover segregation and identification as well as policies regarding rework or acceptance under concession / deviation.

6. Corrective and Preventative Action

Corrective action is a problem which already has occurred and an immediate remedy is required.

Preventative action is taken in order to prevent future recurrence of a problem .

7. Handling, storage, packaging, preservation and delivery

The Builder is expected to establish and maintain procedures for handling, storage, packaging and delivery. The intention is to ensure that product is transported, stored, packed, preserved and delivered in such a manner that its quality is protected against possible damage or deterioration..

Q-Tips - Suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Section in the form of Q-Tips - comments with italicized head type like this.

4.1. Process Control

4.1.1 General

The purpose of Process Control is to identify and implement methods of controlling the operations involved in building envelope construction. This requirement applies to all activities which directly affect the quality of work supervised and/or performed by the Building Envelope Provider.

4.1.2 Definitions

NOTE: Throughout this particular Chapter of the Manual:

Building Envelope means the horizontal, vertical and inclined assemblies which intercede between the interior and external environments

Building envelope construction means activities, operations and processes involved in erecting of the Building Envelope, and including necessary installations, insulation, cladding and finishing, as applicable.

Construction Work Log Book means the form of diary or similar record kept by the Site Superintendent.

Process means any operation that is conducted according to defined parameters.

Process control means activities involved in monitoring of the construction process aiming at continual determination of building envelope quality

Water management strategy means the combination of design and construction measures which controls the various forms of water which attempt to breach a building envelope.

Work Instructions mean directions, whether oral or written, which are in excess of standard construction practice. In the case of the Building Envelope, these would typically be directives specifically addressing envelope concerns.

The Best Practice Guide for Wood Frame Envelopes in the Coastal Climate of B.C. has an excellent, more detailed glossary of terms.

4.1.3 Responsibility

QMR Responsibilities

- ☐ The Building Envelope Provider's Quality Management Representative (QMR) is responsible for providing requirements and guidance for building envelope construction controls and for workmanship acceptance criteria.
- ☐ Identify Workmanship acceptance criteria.
 - Q-Tip: Keep it simple*** - Many acceptance criteria may be simply but accurately stated. For example, if I see a piece of peel & stick membrane with a knife mark of any size or depth on it, the piece is rejected. Not all acceptance criteria are simply stated, but a surprising number are, and should be communicated to site personnel. Other examples:
 - ☐ I should not see any staples through bldg. Paper/ Housewrap
 - ☐ If I can see a peel & stick membrane at completion of cover, it's installed wrongly.
 - ☐ If I can see splinters on a cut, it will cut the membrane going over top.
 - ☐ add your own....

Building Envelope Reviewer Responsibility

- ☐ Where these vary or appear to vary from the standards inherent in design documents or existing codes, standards and trade practices, the QMR submits the variance information to the Building Envelope Reviewer for review and acceptance.
 - Use the Submittal Review form in the Forms section of the Protocol as one means of identifying varying information.*
- ☐ Establish Submittal review procedure
 - How many copies, to whom and in what sequence*
 - Identify parallel approval streams, if any*

- ☐ Distribute Submittal review forms

Q-Tip - Tell it Like it is - Why not have submitters use your submittal form as their cover sheet. You can identify items like: ☐ Conforms to specifications in all respects; ☐ Turnaround time requirement; ☐ Contact for questions; ☐ Any proposed variations/ substitutions/ alternatives?(Be honest)

Site Superintendent Responsibilities

- ☐ The Site Superintendent controls operations which may directly affect the outcome of building envelope construction process performed by the Contractor, and maintains a record of these activities in a Construction Work Log Book.
- ☐ The Site superintendent establishes a Log Book.

4.3.4 Process Control Procedures

Q-Tips - A Simple Approach to Organizing - Although 10 categories may seem 9 to many for some, we have used the following information management system on our projects for many years, with excellent results.

There are so many potential Process Control procedures that, in this Manual, only a few have been highlighted. It is expected that during the Review phase of this Draft, many procedures will be added by reviewers. It is further expected that each subscriber to the Quality Assurance Protocol will amend these recommendations to suit the particular aspects of their role and business.

In our professional practice as Architects, building scientists and Certified Professionals, we have found it convenient to divide projects into ten phases. For convenience, and as an organizing device as good as any other, we have organized Process Control Procedures within those same ten phases.

As these are procedures, i.e., directives, they have been written in the active imperative voice, much like specifications.

1 General/ Administration

- ☐ At every step in the process, think of means to transfer the project's water management strategy into the completed building envelope.

This is where the concept, "Think like a raindrop" comes into play.

- ☐ Define water management strategy

Q-Tip - Charting the Path of a Raindrop - We are aware of one Builder/Developer whose Consultants' required drawings include diagrams showing the drainage paths from every horizontal and inclined surface on the project, right down to the foundation drainage and sewer connections. In the same way that slab profile drawings have become commonplace in the past few years, perhaps drainage diagrams will follow.

b) Maintain Process Control activities according to the applicable Best Practices that provide guidelines for building envelope construction.

Either use the "Best Practice Guide" or develop your own as a valid, formal alternative.

- ☐ Confirm Best Practices to be used on project. Source = _____

Q-Tip - Your Own Best Practice Guide - No two individuals in the design and construction fields will agree on the best way to design something. Architects cannot be expected to adopt someone else's design "whole cloth", even without considering copyright issues. And builders cannot be expected to abandon their preferred materials, subcontractors and suppliers. The CMHC Best Practices Guide provides a vehicle for evolving one's own Best Practices in a professional and defensible fashion. The BPG details have a well developed theoretical basis. Where a Designer or Builder has an alternative approach to achieving an equal or better result, the reasons for variance can be described in relation to the BPG details, so that either the "better mousetrap" may be challenged, or integrated into a specific project.

- ☐ Use Work Instructions to define methods of control only where the absence of guidelines could have negative affect on the quality of the building envelope.

Avoid meaningless statements such as "Use best workmanship..." Either specify what's expected, or accept the current standard.

- ☐ Define work instruction format - RFI (Request for Information), Site Question, etc.

Q-Tip - Prescribing Construction Sequence is a Tricky Business - The architectural and engineering professions have always been somewhat unhappy about defining sequences of construction operations. The concern is they may be seen to be doing the Contractor's job, thence become liable for resulting problems. However, there is nothing wrong with suggesting sequencing on drawings or in the field through the Contractor's site personnel. Brainstorming and trying new ways to deal with new construction methods are perfectly acceptable, provided Contractor personnel are present and issue any eventual instructions.

Document Work Instructions and relate them to customer requirements.

2 Planning

- ☐ Plan construction activities in logical sequences to minimize rework and/or damage to completed installations by succeeding operations

This seems self-evident, but continues to occur. Within a structure, it can lead to compromised fire safety, acoustics, etc. In the building envelope, it may lead to failure.

- ☐ In designing structures, evaluate design concepts in relation to planning authority regulations which impact on building envelopes, such as roof overhangs.

A requirement to have, or not have, a roof overhang should probably drive the selection of wall materials, for example.

Q-Tip - Formal Evaluation of Building Envelope Concepts - We have incorporated elements of the Best Practices Guide, as well as other knowledge and experience, into our formal reviews of our own and others' designs. Included in those reviews are the Building Envelope Survey's findings about roof overhang vs. likelihood of problems, plus the relationship of weather exposure to envelope concept. If this type of analysis were undertaken at the outset of a design, we have no doubt some designs would evolve differently - not badly, just differently.

- ☐ Capture the client's Ideal Design Elements for the project.

Q-Tip - Capturing the Customer's Ideal Project Elements - In our design work we draw out from Clients their Ideal Design Elements (IDE's) of a project - the

idealized outcome of our efforts, in their own words. Like any essay or like this Protocol, these elements may be grouped under appropriate headings. For most projects, a Customer's Ideal Project Elements (IPE's) may be similarly captured. As building scientists, we identify the Customer's IPE's as related to longevity, maintenance strategy, tenure, etc. right at the contract stage. Any Building Envelope Provider should be able to similarly identify their Customer's IPE's, capture them on items like purchase orders and work instructions and thereby validate customer requirements throughout a project. If an instruction seems contrary to the Customer's IPE's, simply identifying the conflict will often lead to revision of the instruction (when the conflict is identified) or refinement of the IPE's. Either way, the Provider may proceed with clarity and a confirmed set of instructions.

e) Where applicable, use Work Instructions to define the specific activities involved in building envelope construction and methods of monitoring project progress.

Base Construction control processes on documented building envelope acceptance criteria.

3 Design

- ☐ Label or key on design drawings those elements which are critical to the successful performance of the building envelope

A related practice involves specifying materials whose finish characteristics are such as to make their place in the envelope self-evident. For example, the bright yellow of Dens-Glas®, the electric blue of Bakor Blue Skin®, the labeled white of Tyvek®, the bright colouration of various fire stop compounds, etc. These kinds of products make on-site review and instruction simpler, e.g., "If I can see the yellow Dens-Glas, something's missing."

- ☐ Develop drawings, especially details, in a format which facilitates use on-site.

Many drawing sets never leave the construction office, partly because of the impracticality of their size. Smaller detail formats such as 8-1/2x11 or smaller facilitate use on-site. An on site copier also helps, allowing volume dissemination without concern for losing originals.

- ☐ Include the building science background information with details.

Workers are bright. Tell them why something is important and they will often get it, do it and do it better than specified.

- ☐ Provide opportunities for design feedback on drawings

For example, issue details as double sided, with one side containing the detail and the other containing space for logging installer comments and suggestions.

- ☐ Capture the knowledge on your drawings for future reuse

Q-Tip - Key Notes - Most CAD programs now have the ability to store notes in a variety of naming formats, including the 5 digit standard specification format. These notes are stored in a master location, applied to specific drawings as appropriate and reprinted on each sheet in an efficient fashion. This approach allows a firm to capture its knowledge database, evaluate how well it has been communicated, edit on an ongoing basis and transcribe the "latest and greatest" to each successive project.

4 Permitting

- ☐ Tell the water management "story" in the drawings and documents submitted for building permission.

A plan checker, whether internal to the Designer or with a Regulatory Agency, will be better able to review building envelope information where the water management strategy has been clearly explained.

In Vancouver, the energy utilization "story" also needs to be told at this time in the process.

- ☐ Identify areas where proposed designs cannot conform to code, and document reasons for nonconformity.

Q-Tips - Is your Building "To Code" - Probably not! Building codes are the usual minimum acceptance criteria for construction. However, they are not perfect and contain internal contradictions, such as the requirement to simultaneously fire rate the underside of a balcony and vent it. In the building envelope arena, Part 5 of all of the National, Provincial and local (Vancouver) codes calls for some performance criteria which are impossible to meet at any construction standard below an engineered curtain wall. So, most building authorities do not enforce some aspects of the codes. Clients should be clear about which aspects of codes are not met, so that they may either a) upgrade construction quality or materials, or b) knowingly ignore codes in some areas (All lawyers reading this Protocol take note!)

- ☐ Maintain Building envelope construction process records in a Construction Work Log Book.

All procedures should ideally be logged.

- ☐ Include receiving, in-process and final inspection records as part of the evidence of the building envelope construction control.
- ☐ Analyze the project delivery model proposed for the project as to impacts on building envelope construction

For example, a construction management project with phased "packages" of tenders will need to pay more attention to envelope construction sequencing than perhaps the traditional stipulated sum approach.

- ☐ Combine related trade contracts into a single contract to reduce coordination problems and concentrate responsibility.

For example, some subcontractors who used install stucco only now handle substrate building papers, self-adhering membranes, etc.

- ☐ Prepare, update and distribute a directory of all Quality Management Representatives (QMR's) associated with the project, in addition to any other directories.
- ☐ Consider each communication required to achieve the above as a "template", reusable in future similar circumstances.

About 90% of our building science activities are documented on templates which have been customized for each job and occurrence, in a fraction of the time required to invent them from scratch..

5 Tendering

- ☐ Communicate requests for alternatives or substitutions to the Building Envelope Reviewer, with sufficient information to allow for evaluation.

Q-Tip - Just the fax! Most requests for substitutions and alternatives still arrive by fax, usually with a tight review deadline. If reviewers make their information requirements clear at the outset of a project, they should expect decent submissions. Suggest to suppliers that they keep manufacturer's literature, test data, generic shop drawings, reference lists, etc. in a bulldog-clipped file by their fax machine. Then, when they request approval of an alternative, they can simply attach a cover sheet to the standard package. Each time a reviewer suggests there is a piece of data missing, it can simply be added to the package for future use.

Types of data of interest to reviewers:

- ☐ Test data indicating conformance to Canadian standards
- ☐ Application directions
- ☐ References naming the same type of professional as the reviewer is
- ☐ Limitations on product usage - incompatibilities, temperature ranges, etc.
- ☐ Sample warranty & means/cost to obtain same.
- ☐ Turnaround time needed for incorporation into tender/construction

A Submittal Review form is included in the Forms section of this Protocol.

- ☐ When evaluating tenders, especially alternate prices, factor in the maintenance/ call back costs over the extended warranty period.

6 Construction

- ☐ Establish building envelope requirements at the initial site meeting, and review the Project's water management strategy on this occasion.

A sample building envelope design review meeting agenda is included with the Protocol.

- ☐ Use construction mock-up's to address sequencing issues in advance of full supplies arriving.

Q-Tip - Never Enough Mock-ups - Construction documents should specify a minimum set of mock-up requirements. You can't just spring this requirement as a freebee. However, in our experience, once Contractors understand that they can also use mock-up's to propose an alternative to specified construction (a "better mousetrap"?), they will experiment and seek Designer approval for the variations. On a current project, the "Peel & Stick" Contractor proposed an alternative procedure which improved the quality of window sill gussets while saving him significant time - a classic win-win.

It is important to construct mock-up's as early and as completely as possible, not just a week or so ahead of schedule trades start. Frequently, specified products do not work together, and the mock-up provides the opportunity to address these issues before quantities of material have arrived.

- ☐ Explain at the first site meeting or sooner the roles of the various parties having input/ responsibility/ authority/ liability for the building envelope, and the resulting requirements for communication.

We regularly have site personnel completely disbelieve that professionals have unlimited, perpetual, personal liability. (Perhaps that's an indication of how crazy we are!)

- ☐ Track all questions, site meeting inquiries, etc. at the site meeting minutes. Date the time they arose and leave them on subsequent meeting notes until they are resolved.

Polygon's site meeting minutes are artfully brief, usually less than 2 pages. My only criticism is the lack of item dating. Conversely, this may avoid embarrassment where an item endures over long.

- ☐ As suggested elsewhere with field reviews, numbering site meetings will reduce the incidence of someone missing a critical site meeting note.

7 Changes

- ☐ Maintain a list of changes and log the progress of those changes

Refer to the Forms section of this Protocol for a Document Log format suitable for this purpose.

This log should be appended to each site meeting minutes as a reminder of status - also submittal logs.

- ☐ Add to specifications for "cutting and patching" consideration for the building envelope, both as to types of cutting requiring pre-approval, and specific patching instructions designed to preserve the building envelope integrity.

- ☐ Copy the Building Envelope Reviewer (BER) with all Change correspondence.

A Building Envelope Reviewer might not wish to log all changes in a formal fashion, however it is dangerous to limit exposure to changes. Often the Reviewer will see significance in a proposed change which others thought was of no envelope consequence. The Reviewer should do the editing for relevancy, not others.

This need not require the BER to be yet another link in the process of change approval. Simply require the BER to react to proposed changes within a reasonable specified time frame.

- ☐ Copy the Quality Management Representative (QMR) of the companies affected by changes with proposed change information.
As with the BER, they will react to change issues if given a reasonable time frame which parallels formal change approval.
This dissemination of information is particularly important with Site Instructions, which are often implemented immediately after issuance, because no contract change is anticipated.
- ☐ Copy the Building Envelope Reviewer with any amendments to permits.
Often, exterior materials or forms are a result of permit amendments. These may have a major impact on building envelope design and construction.

8 Submittals

- ☐ Prepare a list of submittals which the Building Envelope Reviewer needs to review, and log the progress of those submittals.
Refer to the Forms section of this Protocol for a Document Log format suitable for this purpose.
This log should be customized for each project.
Ideally the log should be appended to each submittal review as a status reminder.
If the site supt. Has a master log covering all reqts. Of all consultants, this can be appended to site meeting minutes.
- ☐ Require shop drawing submittals to include information regarding surrounding conditions and how the shop drawn materials fit within the building envelope
This is a major struggle, as the construction industry continues to think about products as discrete items, with connections to the envelope "by others."
- ☐ Require engineered shop drawings to be sealed at the first submission, as evidence that the designer has reviewed substrate and site conditions and incorporated same in designs
Another major struggle. Try rejecting a few submittals simply on the basis of an absence of appropriate pre-review evidence (i.e., seals). You may lose a few clients, but you will not lose any sleep (We have yet to lose a client on account of this approach).

9 Field Review

- ☐ Prepare a detailed list of required Building Envelope Reviewer field reviews, and maintain it in a visible location on site as a Log of BER status.
This can also be a useful index or Log of field review activities.
The concept of a minimum list of required field reviews makes some professionals nervous, however we have no better solution at this time.
Builders use the list as a checklist and reminder of what needs to be reviewed before the next construction phase begins.
This list and its status should be appended to each field review as a reminder of what's completed and what's expected yet.
In our experience, site supts. Appreciate these lists, which act as reminders for them.

- ☐ Copy field review reports to all QMR's whose companies are affected by the field reviews.

Field review reports should note what's being done right as well as what's not. Communicating the good to QMR's reinforces the success of Quality Assurance as well as highlighting what works - positive reinforcement.

- ☐ Prepare a list of required field samples (concrete tests, mortar samples, etc., and copy the BER and affected QMR's with test results.
- ☐ Use checklists for repetitive field reviews.

Some samples from our work are attached in the Appendix.

Polygon developed for the Greenwich project checklists covering Framing rough-in, pre-drywall inspection and air tight drywall review. These are not included in the QAP as they are proprietary, but the concept is straightforward.

- ☐ Maintain an ongoing "punch"/deficiency list and update it at each field review. The increasing quantity of field reviews occasioned by more focus on the building envelope makes it easy to forget to revisit previously noted envelope deficiencies.

This very sensible item seems one of the most difficult to obtain, in practice.

Refer to the sample in the Appendix for a possible layout and format.

Q-Tip - Tell 'em What you Want - Most Site Superintendents are very willing to do whatever a field reviewer requests in order to clear up a deficiency - call for re-review, take a photo of the repaired deficiency, etc. Field reviewers should make it clear whether an installation is acceptable or not, and if not, what recording action is needed in addition to remedial action. We use the following codes: ☒ **Accepted work** is indicated with a tick; ☐ **Work not accepted or incomplete** is indicated with an unticked box; ☐ **F** _____ (**Contractor fill in date when ready**) - work requiring a Follow up Field Review is indicated with an unticked box and the "F-" prefix as shown here; ☐ **P** - deficient work which may be covered up after correction, but of which the Contractor must take a picture illustrating the repair/completion, for presentation to us at the next meeting, is indicated with an unticked box and the "P-" prefix as shown here; ☐ **C** _____ (**Contractor initial & date to confirm when corrected**) - indicates deficient work which may be covered up after correction/ completion, Contractor to initial confirming completion

10 Completion

- ☐ Prepare a list of information requirements for occupancy, both regulatory requirements and warranty/ maintenance requirements.
- ☐ Throughout the Project, collect building envelope maintenance information, including shop drawings, samples, manufacturers' literature (especially maintenance instructions)
- ☐ As each trade's work is completed, organize a pre-occupancy review with the Building Envelope Reviewer and the appropriate QMR's, to review the completed work as to deficiencies, etc.

4.1.5 Process Control: Records

- ☐ Maintain records in regards to the building envelope construction process activities.

Item Name

Responsibility

1./	Work Instructions	Site Superintendent /Quality Management Representative, as applicable
2./	Construction Work Log Book	Site Superintendent
3./	Review & Inspection records	Site Superintendent / Quality Representative, as applicable

4.2. Inspection and Testing

4.2.1 Inspection and Testing: General

Inspection and testing at the building site cover three areas that have a direct influence on the quality of the finished building, its overall quality, proper functioning and expected durability.

- ☐ Use Receiving Inspection to review the quality of materials received on site, including materials supplied by the Customer.
- ☐ Use In-process Inspection to cover the work performed on site by the Builder, Suppliers and/or Installers. This includes mockup preparation.
- ☐ Use Final Inspection to review the finished product, or a defined part thereof, i.e. to a specific stage of the project such as concrete work, electrical, framing, cladding, etc.

The definitions contained in this Section of the Quality Manual address basic requirements constituting the very foundation of the Contractor quality system.

NOTE: The word inspection, where used in this Section, may be taken to mean "review".

4.3. Receiving Inspection And Testing

4.3.1 Receiving Inspection and Testing: Introduction

Whenever goods are purchased from a Supplier or the specific services of a Sub-contractor or Installer are ordered, the quality of the received products or the services outcome should be verified. This Section of the Manual addresses the means of verifying those outcomes.

- ☐ Use a **Receiving Log** to record the quality of incoming products and services.

These actions help assure the quality of procured goods and services and assist in proper inventory control at the building site. Early identification of nonconforming goods or services enable their prompt return or rework before any substandard product is used by the Contractor. A well maintained Receiving Log (or any other document of similar nature) provides documented evidence of product and service quality. This evidence may be invaluable when it is required by an insurance company or for legal purposes (i.e. when product was damaged during handling or transportation or in case of dispute between the Contractor and the Supplier or Sub-contractor). In some cases receiving Inspection of specific products may be required to comply with regulations or industrial codes. The quality of goods and/or services arranged by the customer for incorporation in the final product should be verified.

For practical reasons documentation of these activities is kept to a necessary minimum.

4.3.2 Receiving Inspection: Responsibility

- ☐ The Quality Management Representative or designate is responsible for the Receiving Inspection activities.

The "designate" is usually a site superintendent or onsite Project Manager.

- ☐ The Site Superintendent is responsible for basic Receiving Inspection.

Unless specifically decided otherwise, the Receiving Inspection activities focus on general compliance of the purchased goods with contents of the Purchase Order issued by the Builder (verification of Purchase Order Number, received parts Part Number and quantity).

- ☐ Assess the overall condition of the purchased product, looking for evidence of handling damage or symptoms of deteriorating quality of the incoming goods.
- ☐ Identify special handling requirements at this point, for consideration under Section 4.10 of this Chapter.

4.3.3 Receiving Inspection: "Critical" Product

Identify all "critical" product purchased by The Builder.¹ For building envelopes, this would include all materials, products and systems providing resistance to water, air or vapour transmission, such as

"Critical" product is generally defined as a product having a direct and significant influence on the quality of the exterior of multi-storey wood frame buildings. This relates in particular to nonconformance of the purchased goods or services which may cause customer complaints or significantly reduce expected building envelope durability.

- ☐ Cladding and cladding fasteners
- ☐ Strapping or girts used to create drainage cavities, and fasteners
- ☐ Moisture/air/vapour barrier materials, including housewrap, building paper, polyethylene, roofing, waterproofing membrane, self adhered membrane and the associated primers
- ☐ Items providing physical protection for moisture barriers, such as flashings
- ☐ Items penetrating moisture/air/vapour barriers such as guard rails, mechanical and electrical penetrations such as outlets, ducts, etc.
- ☐ Gutters, rainwater leaders and drains and associated fasteners
- ☐ Gaskets and sealants
- ☐ Doors, windows and glazing

NOTE: the above list is not all inclusive, and should be expanded/edited for each specific project.

Done by the Quality Management Representative in conjunction with the Builder's management

Q-Tip - The Earlier the Better - For years we have been identifying "long lead" items for special attention. We now need a new class of long lead items - those for mock-up construction.

Q-Tip - Mini-Mockups - As products arrive on site, it is helpful to verify their "fit" with other products and systems earlier rather than later. Relationships such

as flashing to trim, sill pans to windows, mechanical exhaust hoods to wall components, etc., may be tested and refined in this way before major deliveries occur.

4.3.5 Receiving Inspection: Inspection Level

- ☐ Establish for each product the nature and frequency of receiving inspection

An example from our own experience: Although Tyvek "Housewrap" has not been shipped to Canada for about 2 years, the occasional roll shows up on a construction site. This can be of critical importance, as "HouseWrap" does not meet building code requirements for an air barrier, unlike the successor product, "HomeWrap." For this reason alone, we recommend every roll of Tyvek received on a site be visually examined to verify it is not "HouseWrap."

Unless specified otherwise, apply the following principles:

- 1.) Receiving inspection shall always be performed when:

- ☐ there is obvious damage to the product in its "as supplied" condition
- ☐ the supplied product is classified as "critical"
- ☐ the quality of the product purchased from a given source was previously found to be non-conforming to the Builder's requirements. Subsequent deliveries of the subject product from the same source shall be verified, until such time as confidence in the Supplier's performance has been re-established.

- 2.) **Basic Receiving Inspection** shall be performed for all purchased product, unless advised otherwise. Basic Receiving Inspection shall embrace:

- ☐ identification of the purchased product against shipping and order documents
- ☐ confirmation of the quantity of the received goods
- ☐ visual inspection looking for obvious evidence of transport/handling damage, if any.

4.3.5 Receiving Inspection: Procedure

General requirements:

- ☐ Whenever practical or required by relevant regulations, request a Certificate(s) of Conformance for all purchased product classified as "critical".
- ☐ Maintain a Receiving Inspection Log
- ☐ Product shall either be labeled so that a Reviewer can ascertain when the product is in place that it is correct, or, where product labeling is deficient in place, bundle labels, packaging, etc., shall be kept to identify the product, and the evidence shall be labeled with the location(s) it was installed in.

We have a stated preference for materials which are self-labeled, and we make no bones to suppliers that they should label materials if they seek our approval for their use on our projects.

The following procedure applies to the Receiving Inspection of the purchased product:

The Builder personnel involved in purchasing shall:

- ☐ provide the Quality Management Representative with information pertaining to the quality of the purchased product
- ☐ communicate to the Suppliers all information regarding the quality requirements of the purchased product
(If there's a problem, don't keep it a secret)
- ☐ The Quality Management Representative or nominated designate shall perform Receiving Inspection.
- ☐ A "HOLD" Tag shall be issued for product which are found to be nonconforming.
- ☐ The Quality Management Representative or Site Superintendent shall advise the Builder's purchasing personnel as to the disposition of the nonconforming product

4.3.6 Receiving Inspection: Records

- ☐ Maintain the following records:

Item Name	Responsibility
1./ "Critical" Product List	QMR
2./ Certificates of Conformance	Receiver / Site Supt
3./ Receiving Log	Receiver

4.4. In-Process Inspection and Testing

In-process Inspection applies to the work performed at the building site by the Builder or Installers.

The very nature of the building envelope makes it essential to verify the quality of workmanship and the quality of materials used in construction as soon as possible, at the interim stages of construction. Early correction of identified nonconformity helps eliminate cases of unsatisfactory building envelope quality, which might otherwise become obvious only at the later stages of project development. This approach is particularly effective when in-process inspection is performed at the end of each specific project development stage (i.e., at trades "hand-off", etc.), catching substandard workmanship or defective materials before their rectification becomes "uneconomical" or "impractical".

Evidence of acceptable quality may be of great importance where a customer questions the quality of the building. In-process Inspection at specific stages of building construction is also required to comply with building regulations and may constitute a pre-condition to an interim approval of the development by a building inspector.

- ☐ Record inspections using a **Field Review Report** which is designed where possible as a simple checksheet, which provides information pertinent not only to the matters related to quality but also suitable for overall monitoring of the work in progress.

Refer to the Appendix for some sample Field Review Reports

Q-Tips - How to Evolve a Field Review Report (FRR) - Many Designers/ Reviewers use a simple memo pad on which to record field review comments. This works well for "custom" or unique situations, but less so when the field

review in question is repetitive as to content, for example, the insulation at each level of the building. With a bit of care, a base FRR document can be built up over time to incorporate an unlimited number of variations describing the repetitive but essential field reviews required for a building envelope. Appendix A includes a selection of Field Review Reports designed for manual fill-in and all derived from different layers of the same computer file.

Q-Tip - Which Reviews Have I Done? Field reviews occur both on an "in progress" basis and at specific events, such as just prior to applying cladding. Event-based field review requirements can be predicted and become an attachment to each field review, so that the review not only addresses current observations but reminds the reader what event-based field reviews have occurred already and which remain to come. Site superintendents in particular like reminders as to when next to call reviewers.

Q-Tip - Field Review as Checklist - Many aspects of field review are repetitive as related to specific components or assemblies. Hardware and software exists allowing computerized and hard copy checklists to be developed for the full range of materials and systems on any project. These checklists will assist the reviewer in reviewing all appropriate aspects of an installation. As a bonus, where the checklists are made available in advance to Builders, they serve as a reminder of reviewer expectations.

Q-Tip - FIRESTOPPING INSPECTIONS - Many firestop products are now colour coded. However, the manufacturer's literature which describes in detail appropriate applications is too expansive to carry around on field reviews. When the firestop supplier sends through literature for review by the building envelope reviewer, the transmittal should indicate (via matrix, table, etc.) which product, including its colour, which applies to each type of penetration. This transmittal can be easily carried around by the building envelope reviewer and Builder, improving the chances of catching discrepancies and allowing easy selection of the right material where openings are found to be incomplete.

Q-Tip - DIFFERENTIATING SIMILAR MATERIALS DURING INSPECTIONS - Some envelope materials such as roofing membranes, waterproofing membranes, self-adhering membranes (i.e., peel & stick) may be on a site in a number of forms and products. Although submittals may have samples, the complexity of submittals makes them inappropriate to carry along on field reviews. However, small samples of the range of such materials can be adhered to a piece of cardboard or stiff paper and labeled as to name and approved uses. This sample card can be easily carried along on field reviews for instant checking where a particular installation is suspect or direction is requested as to the appropriate product for a particular condition.

Q-Tip - PRE-AUTHORIZATION FIELD REVIEWS - Building Envelope Reviewers are frequently requested to verify installations prior to succeeding activities starting which are dependent upon or will cover the areas to be reviewed. It is useful to have the foreman of the trade scheduled to proceed next attend these pre-authorization reviews. Although most specifications and purchase orders contain language which requires successive trades to accept the preceding work, this acceptance review is often missed. Although the responsibility may clearly lie with the succeeding foreman, many debates about quality will be avoided if acceptance is confirmed through attendance at

the pre-authorization review. One additional result is that the Building Envelope Reviewer can confirm the interface between successive trades.

Q-Tip - Leaving the Door Open - A major frustration of all inspectors is their inability to see what happens once an assembly is covered. But sometimes there is a way to check after the fact. We recently became annoyed at the possibility of excess mortar droppings in a cavity. The mason simply removed periodic bottom course bricks, which was possible once the bricks had achieved their initial mortar set. The bricks have been left out, allowing us to continually examine the accumulation of mortar at the bottom of the cavity, and allowing the mason to remove that excess.

4.4.1 In-process Inspection and Testing: Purpose

The purpose of this procedure is to define guidelines for in-process quality verification at the construction stage of the building.

In-process Inspection ensures that:

- ☐ the constructed building conforms to the Product Specifications, Best Practices and/or Customer requirements;
- ☐ a substandard, non-conforming building envelope or a part thereof, when identified, is held in abeyance until deficiencies are corrected; and
- ☐ the losses caused by the construction of nonconforming building envelopes are minimized through early detection of the non-conformity;

Q-Tip - Instant Research - It is important to remain open to findings in the evolving field of building science. We recently discovered that moisture content tests were yielding higher readings in the immediate vicinity of nail concentrations in wood frame construction, such as at built up beams and columns - often areas of moisture concentration, but not the extremely elevated readings which were being seen in the nail concentration areas. When readings were taken 3-4" away from the nail concentration, m.c readings dropped significantly, to expected levels. The general message is to remain open to field research.

4.4.2 In-process Inspection and Testing: Responsibility and Procedure

Q-Tip - Keeping Inspection Costs Down: Inspections have traditionally been provided by Designers at their sole discretion. Knowledgeable Designers and conscientious Building Envelope Reviewers gauge their quantum of field reviews in part based on the materials being used on the project.

The Following types of materials and systems will tend to require more field review for the reasons specified:

- ☐ Fluid applied roofing and waterproofing membrane (varying thicknesses and critical importance of substrate condition);

Notwithstanding this, Polygon has a preference for fluid applied products. There were many field reviews of these products and a fairly high incidence of initial failure.

- ☐ Blown in or blown on insulations (varying thicknesses);
- ☐ Coatings of any kind (varying thickness and substrate application requirements)
- ☐ Multicoat or multistep products such as stucco, fluid/mesh membranes (weather changes between coats, multiple progressive substrate review requirements)
- b) Systems where there is a mix of proprietary and non proprietary materials (untested compatibilities)

The following types of materials and systems will tend to require less field review for the reasons specified:

- c) Applications with a minimum of steps and products;
- d) Systems where all products are proprietary and compatibilities are established in advance
- e) Applications where through penetrations remain visible, are self-healing and are durable.
- f) Applications where all product thicknesses are predetermined and easily verifiable.

The Building Site Superintendent, the Building Envelope Reviewer and the Builder's Quality Management Representative (QMR) are responsible for In-process Inspection. Among other things, this means:

- ☐ The Site Superintendent advises the Building Envelope Reviewer (BER), with reasonable notice, when a BER field review is requested.

Note that it remains the BER's professional judgment as to whether and ultimately when field review is required.

- ☐ The Site Superintendent or designate attends at all in-process field reviews and distributes reports thereof to those Suppliers and Installers affected.

On the Greenwich project, Polygon assigned a Quality Control Supervisor in addition to the traditional site superintendent. The site supt. Provided traditional superintendent functions such as coordinating trades, scheduling work and material deliveries, etc. The Quality Control Supervisor performed patrol inspections of work in progress, attended field reviews with professionals and took responsibility for solving issues arising from these reviews and other quality measures.

- ☐ The Builder's Quality Management Representative (QMR) or designate performs a Patrol Inspection function and provides assistance to other Builder personnel during In-process Inspection on an "as required" basis.

The importance of "patrol" inspection by the Builder's QMR cannot be overestimated. Building Envelope Reviewers will waste enormous time, hence resources, if they continually reject work because it is not "ready" for their review.

The BER may not / should not issue an assurance regarding the building envelope until deficiencies identified during in-process field reviews have been rectified.

Authorized Builder personnel:

- ☐ perform in-process inspection activities;
- ☐ put "on hold" non-conforming elements of the building envelope;
- ☐ release conforming elements of the wood frame building envelope for the next construction stage, except where continued construction may be impacted by "on hold" areas;
- ☐ maintain adequate records of In-process Inspection and Testing

The responsible Quality Management Representative (QMR):

- ☐ inspects elements of the wood frame building envelope areas on "HOLD", whenever reasonably required as a result of the completion of repairs
- ☐ provides recommendations regarding rectification of nonconforming elements of the wood frame building envelope (in conjunction with authorized Builder personnel)

It is important to note that Designers cannot direct the Builder or the Builder's work force to perform in certain ways. Hence the use of the term "recommendations."

- ☐ re-inspects or verifies re-inspection of the reworked / rectified areas.
- ☐ confirms adequacy of repairs

Q-Tip - Pass/ Fail Marking- Testing of items such as windows is becoming commonplace, but the identification of what has been tested, where, when and how it did is much less well documented and tracked. One simple approach is to affix a test result sheet to the item tested, listing whatever information is important to the team - certainly the items noted above.

This would be most useful where a high percentage of installations was being tested.

Q-Tip - Fabrication Process Review - Increasingly, complex components such as building panels are being prefabricated off construction sites, sometimes to complicated procedures. Those with responsibility for envelope integrity may review a variety of components at different stages of manufacture or assembly, in which case the task of in-process review is even more daunting. One technique to clarify component status involves writing out the fabrication process steps, fastening the resulting checklist to the fabricated item, then having building personnel sign-off when each step is completed. In this way a reviewer can ascertain exactly what phase of fabrication the building team thinks it has reached.

Q-Tip - Installation Process Review - Just as it is important to check off fabrication processes as they are completed, it is helpful to be able to check off installation procedures, especially at envelope penetrations such as doors, windows and skylites. Not only can installation checklists be affixed to key components and signed off by installers, but key details or procedures could be affixed to the components, both to remind installers of key installation details and reviewers.

Polygon used this approach at the Greenwich site to ensure the relatively complex requirements for ADA assembly at windows were completed in a systematic fashion. Thus reviewers could inspect window installation "in

progress" and know what the Builder thought was complete on any given window.

Mockup Procedures: The following is a recommended procedure for a "critical" element such as windows:

Based on the test drive experience

- ☐ Builder prepares mockup for review off site by Designers, Builders, Suppliers & Installers
On this project, this involved a meeting in Polygon's board room with the Architect, building envelope consultant, site supt., quality control supervisor, vice president(s) development & construction, and experienced supts. From other similar projects. There were about 15 people in the room.
- ☐ Mockup is refined from commentary by all parties and reviewed/ signed off by all parties.
For this project, refinements were agreed "on the spot." Had there been any controversy, one or more refined mockups would have had to be constructed and reviewed off site again.
- ☐ Mockup is constructed in a test location exactly as agreed, and tested for performance
For this project, the mockup was constructed at the window manufacturer's test facility. There were some deviations from the designed details, which were not significant in the end, but highlighted the importance of building exactly as intended.
- ☐ Prior to on site mockup, the Builder meets with all trade representatives of affected trades to review/discuss building envelope concepts.
This is an important step. More and more trades are becoming familiar with building envelope concepts and terminology.
- ☐ After successful testing, a mockup is constructed on site by the designated crew and tested *in situ*
An important step, as it may pick up emergent defects during transportation or erection by actual crews proposed to do the work.
The in situ condition should incorporate typical/challenging conditions, including all necessary finishes
For this project, the in situ test was successful
It is important that the in situ test site be selected randomly so that components cannot be doctored.

- ☐ If any test is unsuccessful, issues are resolved before proceeding to the next step
- ☐ More in situ tests are performed as the project proceeds, to confirm expected quality is being maintained.

Q-Tip - Which Test? The most typical water penetration test for windows is called "ASTM E1105, Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference." The test involves a rain rack, a fan and a test chamber which may be constructed in place.

Q-Tip - Why Test? We have had only 2 window assemblies pass in situ testing first time out in the past 18 months, out of approximately 10 test occasions. Deficiencies leading to water ingress have ranged from the sublime to the ridiculous. We are advised by Builders that Suppliers and Installers pay more attention when they know testing is "in the cards."

- ☐ The Supplier(s) of the product/system in question continue to test random samples after the initial mockup is approved.

At the Greenwich project, 5-10% of all windows were tested for water penetration, which was fortunate as initially, there was an unacceptably high failure rate. Investigation of the causes of leakage led to changes in the window manufacturer's plant operation and successful in situ testing.

The Greenwich window manufacturer developed his own "test recording sheet" to match windows to test results.

The Best Practice Guide recommends a minimum of 1% of windows be tested for water penetration and at least one of the residential insurers insists on that same ratio.

4.4.3 In-process Inspection and Testing: Records

Maintain the following records:

- ☐ "HOLD" Tag - responsibility of the QMR/Site Superintendent
- ☐ "HOLD" Tag Log - responsibility of the QMR/Site Superintendent

Q-Tip - Making a List, Checking it Twice - One frustration of Owners and Builders occurs when they have corrected deficiencies noted by Designers during the course of construction, yet the correction is never acknowledged or "signed off." With envelope issues this may become even more significant if there is water ingress at a later date. Field review reports can include space for the following annotations:

- ☐ Initials by Builder when a deficiency item is complete (may be faxed to reviewer so that deficiency completion may be verified);
- ☐ Coding from reviewer indicating a re-review is required before cover up;
- ☐ Coding from reviewer indicating an item may be covered up after a photo of the repaired condition is taken;

This approach was developed for the Polygon Greenwich project and used by both the Architect and Building Envelope Consultant.

Refer to the Appendix for a sample of how to do this on field reviews.

Q-Tip - Cold Weather Procedures - Various materials, such as stucco, concrete and masonry, have restrictions on their application in low or high temperatures. The Builder should include a standard residential type outdoor thermometer on site, perhaps at the construction site office. Affix a plastic laminated card

behind the thermometer indicating temperatures at which special measures "kick in", and label those temperatures on the card, calibrated to the particular thermometer. Summarize protection measures on cards or checklists and post these inside on the wall adjacent the thermometer, for quick reference.

There are surface temperature thermometers made which will read the temperature of a surface from a considerable distance, allowing for an accurate determination of suitability of a surface for a particular material application.

4.5. Final Inspection And Testing

Final Inspection and Testing takes place when the whole building or a specific stage of the building construction is completed.

For the purposes of this Manual, Final Inspection and Testing is defined as an inspection of the completed wood frame building envelope performed by authorized Building Envelope Review personnel. These activities provide documented input to formal verification of building envelope quality acceptance.

It has to be noted that the outcome of Final Inspection and Testing activities performed by the Building Envelope Reviewer is not a substitute, nor a determining factor which may influence results of formal assessment performed by regulatory authorities such as the building inspector.

The main purpose of Final Inspection of the wood frame building envelope is to enable the Building Envelope Reviewer to reconcile results of preceding inspection stages such as receiving and in-process inspection with the quality of the finished product.

An additional outcome of Final Inspection and Test activities is an opportunity to verify the effectiveness of corrective actions (if any) in cases when substandard quality or other type of nonconformity have been identified at earlier stages of the project.

Where applicable, an assessment of the overall quality of the finished wood frame building envelope should include verification of the records pertaining to the interim stages of construction.

- ☐ Document final Inspection results.

These records combined with the results of interim "per stage" inspection and testing provide vital insight into both the in-progress and final quality of the building envelope. Their existence may help in circumstances when the building envelope is blamed for warranty or post warranty problems and, in particular, when customers complain and action is required. Final Inspection may also be required to comply with building regulations and may necessitate formal endorsement by the Building Envelope Reviewer and/or municipal staff.².

- ☐ As a supplement to checklist type final review documentation, traditional documents such as a Certificate of Substantial Performance and Letters of Assurance may be used.

These Certificates are meaningful in law but do not contain useful data describing the final state of the project.

- ☐ Resolve or "sign-off" in-process deficiencies during the final inspection process.

On the Greenwich project, it became apparent early on that deficiencies were being recorded, but not signed off. This led to the modification of building envelope field reviews to include notations as to how "sign off" of each deficiency would occur. The typical means of achieving "sign off" were:

- ☐ *a supplementary field review*
- ☐ *a photograph of the remediated item conveyed to the Designer;*
- ☐ *a signed annotation on the field review report from the site supt. Attesting to the completion of a deficiency.*

Refer to the sample field review report in the appendix for a suggestion as to how to incorporate these annotations into field reviews.

4.5.1 Final Inspection and Testing: Purpose

To define quality verification activities related to the Final Inspection and Testing of the wood frame building envelope.

Final Inspection and Test activities shall ensure that:

- ☐ the quality of workmanship and the quality of materials used for the inspected wood frame building envelope is verified and conforms to the building specification and related regulatory requirements (if any).
- ☐ inspection and test results, including those relevant to Final Inspection but completed at preceding stages have been verified.
- ☐ All activities involved in Final Inspection and Testing are completed
- ☐ the associated data and documentation are available and authorized.
- ☐ Only a finished wood frame building envelope or portion thereof of satisfactory quality is released for further stages of construction or occupancy.

4.5.2 Final Inspection and Testing: Responsibility and Procedure

The Site Superintendent and the Builder Quality Management Representative are jointly responsible to maintain control over and ensure compliance with all relevant procedures related to Final Inspection and Testing.

The Site Superintendent (s) and the Quality Management Representative, shall ensure that:

- ☐ Final Inspection and Test activities are performed and documented, as defined in this Manual and relevant Standard Operating Procedures (Practices)
 - ☐ specified quality criteria are met
 - ☐ nonconforming elements of the wood frame building envelope (if any) are identified for resolution using the procedures of other sections of this Manual
 - ☐ adequate records of Final Inspection and Test are endorsed and maintained.
-
- ☐ No wood frame building envelope shall be released for an inspection by a Building Envelope Reviewer until all Final Inspection and Test activities are completed and their results are found to conform to specification.

Authorized Building Envelope Review personnel shall:

- ☐ verify satisfactory completion and condition of the wood frame building envelope;
- ☐ identify nonconforming elements (if any) of the wood frame building envelope, as defined in Section 4.13 of this Manual

The "Summary of Project Deficiencies" form in Appendix A is one means to identify on an ongoing basis deficiencies and their resolution.

Q-Tip - Testing Division of Labour - Some suggestions: Clearly define the extent of moisture content and other testing to be carried out on a project, preferably using diagrams or drawings; equip and teach site staff how to do the required testing; monitor their initial performance; when performance is judged satisfactory, delegate an appropriate amount of testing to them; when called for a formal test leading to "sign-off" or assurance, use spot testing techniques to verify that testing by others is satisfactory. - Obviously, this approach depends on trust between the parties.

The Quality Representative or designate shall:

- ☐ ensure that documents related to the wood frame building envelope quality verification are available and/or provided when specifically requested by the customer.
- ☐ Confirm interim (i.e. receiving, in-process) inspection results, where appropriate.
- ☐ Verify if rework / repair of nonconforming elements of the wood frame building envelope has been completed.
- ☐ arrange for repeat of the wood frame building envelope inspection and testing whenever required

4.5.3 Final Inspection and Testing: Records

- ☐ Maintain a record of the final inspection results.

4.6. Inspection, Measuring and Test Equipment

4.6.1 Inspection, Measuring And test Equipment: Introduction

Various of the Builders, Designers, Suppliers and Installers will already have a documented system to control, calibrate and maintain inspection, measuring and test equipment used for the purpose of verifying the conformance of elements of the building envelope to specified requirements.

Develop a properly defined control system for inspection, measuring and test equipment to ensure that:

- ☐ calibration status of measuring/test equipment is identified
 - ☐ calibration of inspection, measuring and test equipment is maintained at defined intervals
 - ☐ storage methods and environmental conditions protect the equipment against damage or deterioration
 - ☐ equipment is properly selected and meets regulatory requirements
 - ☐ when equipment is found to be out of calibration, quality verification results are re-confirmed
 - ☐ calibration records are maintained and made available to the Customer upon request
 - ☐ when selecting appropriate inspection, measuring and test equipment the Contractor shall make sure that chosen equipment will be suitable for this specific purpose.
 - ☐ whenever equipment is equipped with software or use computer for data processing purposes, the requirements regarding its calibration extend also to related software and hardware.
-
- ☐ It is strongly recommended that test equipment users employ independent, certified testing laboratories to provide calibration services on in-house equipment, at intervals defined by those independent companies in conformance with ISO 9001 standards.

4.6.2 Inspection Equipment: Responsibility

- ☐ It is the responsibility of the Quality Management Representative to ensure compliance with all relevant procedures and standards related to inspection, measuring and test equipment control.

4.6.3 Inspection Equipment: Records

- Maintain the following records, either manual or electronic:ⁱ
 - I Document**
 - 1./ Inspection Eqpt - Calibration Labels
 - 2./ Inspection Equipment Calibration Records
 - 3./ Inspection Equipment Log and Calibration Schedule

4.7. Inspection and Test Status

4.7.1 Inspection and Test Status: Introduction

- Identify the status of inspections of a completed building envelope, building envelope components and or related purchased products at all stages of construction or storage of the components on building site.

In the simplest sense, this confirmation is provided by the "Summary of Project Deficiencies" included in Appendix A. This may suffice for building envelopes.

ISO 9001: 1994 Standard requires that "...the inspection and test status of product shall be identified by suitable means, which indicate the conformance or nonconformance of product with regard to inspection and tests performed..."

Q-Tip - Tag it or Bag it - Examples of such inspection status are "awaiting inspection", "accepted", "rejected", "suspect" and "waiting test". Whenever practical this identification can be by tag, prominently displayed bin card, tear-off batch card, appropriate description or other means. For traceability purposes selected methods and means of inspection status identification should also provide information regarding the authority which endorsed or issued related information, and ensure reference to the specific component of the building envelope, if required.

This is an interesting concept, given that building envelopes are seldom so labeled. The practicality and usefulness of this approach vs. traditional field reviews should be explored at the "test drive" stage of the QAP development.

4.7.2 Inspection Status Identification: Responsibility

- It is the responsibility of the Quality Management Representative to maintain control over and ensure compliance with all relevant procedures related to the inspection and test status identification.
- The Site Superintendent or designate is directly responsible for identification of the building envelope and its components inspection and test status. This requirement applies also to purchased products and subcontracted services.

4.7.3 Inspection Status Identification: Procedure

- Develop an inspection status procedure
(As an example procedure)...

ⁱ Refer to the Appendix for sample forms

I	Project Stage, Construction or Assembly Stage	Inspection and Test Status Identification Method	Associated Documents & Evidence	Comments
1	Purchased materials	Received material retained in "Receiving Zone" prior to inspection. "HOLD" tag for material awaiting inspection Authorized personnel initials shall be applied to HOLD Tag on all products released under concession. No identification for conforming material.	Initials of shipper/receiver on product delivery documents. Entry in Receiving Log.	
2	Pre-fabrication, Construction and/or Assembly	"HOLD" tag for material awaiting inspection (including concession, sorted or reworked material) "HOLD" written in red colour. Initials of person who issued "HOLD". No identification for conforming material.	Inspection Status identified on Check Sheets. Entry in "HOLD" Tag Log.	
3	Final Inspection and Test, Building Envelope Review, Commissioning	Building Inspector (Building Envelope Reviewer) Report. No identification for conforming material.	Final Inspection Check Sheet, Reviewer Report	

4.7.4 Inspection and Test Status: Records

- ☐ Maintain the following records, either manual or electronic:

I	Document	Responsibility
1./	"HOLD" Tag	Site Supt, Site Foremen, QM Rep
2./	"HOLD" Tag Log	Quality Mgt Rep
3./	Inspection Check Sheet	Site Foremen, QMR
4./	Concession	QMR
5./	Concession Log	QMR

4.8. Control of Nonconforming Product

4.8.1 Control of Nonconforming Product: Introduction

The Builder is expected to establish and maintain an effective, documented system for control of nonconforming building envelope.

- ☐ Develop procedures for dealing with any non-conforming building envelope, however and whenever identified.

The procedures should cover segregation and identification as well as policies regarding rework or acceptance under concession / deviation.

Key Concepts -

- ☐ the procedure should specify the authority and method for identification, evaluation, segregation and disposition
- ☐ repaired or reworked building envelope or purchased materials should be re-inspected
- ☐ concession/deviation for nonconforming building envelope should be issued by authorized personnel only. Customer acceptance should be sought, whenever nonconformance does not comply to agreed specification of contractual terms and conditions.
- ☐ purchased product which was found nonconforming is separated from acceptable products in quarantine/bond areas whenever practical.

4.8.2 Control of Non-conforming Product: Definition and Purpose

For purposes of this Quality Manual, non-conforming product is a building envelope, element of building envelope, purchased material or service that does not conform to specified requirements.

This definition of nonconforming product extends to the building envelope, purchased product or subcontracted service of unknown or uncertain quality status, as applicable from building site management point of view.

The purpose of this procedure is to ensure:

- ☐ control of the non-conforming product, at any time or at any stage of construction, installation, verification or commissioning
- ☐ avoidance of non-conforming product unintentional or accidental use, processing or installation
- ☐ steps necessary to control non-conforming product release under concession / deviation
- ☐ proper identification, documentation, evaluation, segregation and disposition of nonconforming product

4.8.3 Control of Non-conforming Product: Responsibility

- ☐ The Quality Management Representative maintains control over and ensures compliance with all relevant procedures related to the non-conforming product.
- ☐ The QMR is also responsible for making necessary arrangements and review of the non-conforming building envelope and its proper disposition.
- ☐ Builder's personnel are responsible for investigating reported deficiencies, which shall be reported on a Corrective Action Request or similar means.

4.8.4 Control of Non-conforming Product: Procedure

In order to maintain control of the non-conforming building envelope or elements thereof the recommended procedure is followed:

- ☐ A "HOLD" Tag is made available to Builder's personnel, who are trained in its use.
Responsibility: Quality Management Representative, Site Superintendent and Site Foremen.

- ☐ A quarantine area(s) is established for storage of non-conforming product.
- ☐ Non-conforming product is identified using the "HOLD" tag and entered in a Hold Tag Log.

Responsibility: Site Superintendent

- ☐ If non-conformities are visibly identifiable, a contrasting tape such as Tuck Tape is used to label them.

Best is a material you can write on.

Responsibility: Site Superintendent, Site Foremen, Quality Management Representative

Disposition of the non-conforming material/product is generally as follows:

- ☐ Product okayed, tag removed, product returned, log noted accordingly;
- ☐ the material is deemed acceptable, but of different quality than specified, so a "CONCESSION" is obtained and so recorded.

Responsibility: Site Superintendent, Site Foremen, Quality Management Representative

- ☐ if decision is "REWORK", reworked product is re-inspected after rework/repair is completed and approved, or cycle repeated.

Responsibility: Quality Management Representative

- ☐ if the decision is "REJECT": the "REJECT" disposition of the reject building envelope or its element (return, scrap, other) is indicated on the "HOLD" Tag. Following final disposition of the rejected product the "HOLD" Tag is returned to the Quality Management Representative

- ☐ Corrective Action Request shall be issued, whenever considered appropriate

Responsibility: Quality Assurance and/or authorized Builder's personnel

4.8.5 Control of Non-conforming Product: Records

- ☐ Maintain the following records, either manual or electronic:

Document	Responsibility
1./ "HOLD" Tag	Site Supt, Site Foremen, QMR
2./ "HOLD" Tag Log	Quality Management Representative
3./ Concession	Quality Management Representative
4./ Concession Log	Quality Management Representative

4.9. Corrective and Preventative Action

4.9.1 Corrective and Preventive Action: Introduction

Corrective action usually refers to a problem which already has occurred and when an immediate remedy is required in order to correct the existing situation.

Preventative action is usually taken in order to prevent future recurrence of a problem or in order to eliminate the possibility of the problem which was probably identified on the basis of analysis of available data, historical performance of similar designs, etc.

Properly structured quality problem reporting procedures follow the principles of Edward Deming's Plan-Do-Check-Act (PDCA) formulae, which are fundamental to an effective continuous improvement process. PDCA

begins with detection and reporting of an experienced quality-related problem. The Quality report is subsequently investigated in a manner which ensures, whenever possible, proper identification of the true "root cause" of the problem. When the origin and nature of the problem are positively established, an appropriate corrective action is defined and implemented as soon as practical. The last step evaluates and confirms the effectiveness of corrective / preventative action. If corrective / preventative action is successful and reported problem is eliminated no further action is necessary. If, however, effects of implemented corrective / preventative actions are unsuccessful or only partially successful, the above cycle is repeated until satisfactory remedy is identified and implemented.

- ☐ Allocate the responsibility for instituting corrective and/or preventative action with a person within the Building Envelope Provider organization who possesses an adequate level of authority to stimulate effective countermeasures.

The analysis of reported problems, identification of the "root cause", and execution of defined corrective / preventative action may involve various competent personnel.

- ☐ In order to properly define the origin of the problem, the relationship of cause and effect should be determined whenever possible and/or practical, with all potential causes considered.

Corrective action (repair, rework) may take place immediately after the problem is defined and disposition of the nonconforming product is made by authorized personnel of the Building Envelope Provider. On the other hand the determination of "root cause" is essential before the preventative measures are defined and implemented.

- ☐ The verification of the corrective / preventative action effectiveness should be documented and may include immediate/interim and long-term/final analysis of implemented actions achieved through outcome monitoring.

It is also strongly recommended that effectiveness of corrective / preventative action should be verified and confirmed by the originator of the original complaint or an authority representing interests of the affected party.

Q-Tips - RECORDING QUALITY EXPERIENCE "ON THE JOB" - Bad enough that many construction details are too large to accompany the worker to the corner/opening/service space where the detail is to be constructed - how to then encourage the recording of quality experience with that detail? One suggestion is as follows: 1) Place each envelope detail on the top 1/2 of a standard 8-1/2 x 11 sheet. Place applicable specifications, installation notes, etc. on the bottom half. On the reverse side, provide note space allowing for worker/foreman/site supt. comments as to installation experience - what works and what doesn't. Install a laminator in the construction office and laminate each detail sheet, fold it in half and issue the workers with felt pens to record their observations. Fold the details in half so they fit in a pocket or on a belt loop. One site superintendent of our acquaintance issued "today's details" each morning from the site office, and collected them at day's end.

4.9.2 Corrective and Preventative Action: Quality Problem Definition

A Quality Problem is defined as:

- a) substandard quality of the building envelope not conforming to the design specification or building envelope guidelines;
- g) unsatisfactory (not conforming to specified requirements) performance of the Building Envelope Provider as seen from the project management perspective

4.9.3 Corrective and Preventative Action: Reporting

- ☐ Problems related to the quality of the building envelope shall be reported on a Corrective Action Request form or similar.

The CAR documents experienced problems and may be issued following a customer complaint, assessment of the building envelope by an authorized Building Envelope Reviewer or in any circumstances when the quality of building envelope or its part is questioned.

Note: Pertinent communication is attached whenever a CAR is issued.

- ☐ The originator of a CAR shall ensure that the description of the reported quality problem contains all necessary information allowing for its further meaningful investigation.

The following information must be provided, where applicable:

- ☐ description of the problem/discrepancy
- ☐ affected area identification (location of nonconformity)
- ☐ definition of extent of the reported problem
- ☐ CAR issue date
- ☐ name of the originator

- ☐ A CAR is recorded in the Corrective Action Request Log (CAR Log) maintained by the Building Envelope Provider's Quality Management Representative.

4.9.4 Corrective and Preventative Action: Investigation

- ☐ Investigation of the reported problem is conducted within an indicated time frame (if any) related to the impacts of the problem.
- ☐ Reported problems shall be verified (if necessary) with the originator, and investigation shall aim at identification of the "root cause" of the problem, whenever possible.
- ☐ In order to instigate corrective and/or preventative action(s), the Building Envelope Provider's Quality Management Representative (and personnel of other departments, as directed) shall also investigate historical data, customer complaints and other quality records to detect and analyze potential causes of non conformance.

Investigation results shall be documented on the CAR.

4.9.5 Corrective and Preventative Action: Implementation

- ☐ The outcome of a CAR investigation is reviewed by authorized Building Envelope Provider's Quality Management Representative
- ☐ who shall endorse proposed corrective and preventative action(s) including suggested implementation time frame.

A request for corrective/preventative action may include modification of documented procedures, existing legislation or guidelines, whenever applicable.

4.9.6 Corrective and Preventative Action: Confirmation

- ☐ The Building Envelope Provider management shall take steps to ensure that corrective/preventative actions are implemented effectively and within established time frames.

Effectiveness of the corrective/preventative action is confirmed and documented on the Corrective Action Request form. CAR is re-instated when corrective/preventative action was found ineffective and further investigation is required.

- ☐ The Building Envelope Provider's Quality Management Representative is responsible for communicating results of the implemented corrective and/or preventative actions to the Building Envelope Provider management.

4.9.7 Corrective and Preventative Action: Records

- ☐ Maintain the following records

Item Name	Responsibility
Corrective Action Request (CAR)	Quality Management Representative
CAR Log	Site Manager

4.10. Handling, Storage, Packaging, Preservation and Delivery

Q-Tip – When is a Loading Bay not a Loading Bay? – Many construction sites use as their unloading bay and storage areas any spare piece of ground, often unsheltered. In addition to fostering higher levels of theft and vandalism, this approach exposes building envelope materials and components to deterioration even before installation. Why not identify an unloading area and prepare it as such, c/w a storage surface above ground water and suitable cover. Establishment of this area should form part of the initial site meeting agenda.

4.10.1 Handling, Storage, Packaging, Preservation and Delivery: Introduction

- ☐ The Builder is expected to establish and maintain documented procedures for handling, storage, packaging and delivery. The intention of these procedures is to ensure that product is transported, stored, packed, preserved and delivered in such a manner that its quality is protected against possible damage or deterioration.

This requirement applies to all products, i.e., building materials, purchased and customer-supplied building envelope components, components of the building envelope at interim stages of construction process, and the finished building envelope when ready for inspection by the Building Envelope Reviewer.

Evidence of compliance with the above requirements may be demonstrated in the form of:

- ☐ prevent damage defined methods and means of handling to or deterioration
- ☐ maintained secured storage areas
- ☐ records reflecting receipt and dispatch of building envelope materials and components by authorized personnel
- ☐ identification, preservation and segregation of building envelope materials and components

General requirements regarding packaging do not apply to the building frame envelope except for:

- ☐ identification of building envelope materials and/or components
- ☐ packaging requirements which constitute part of building envelope materials and/or components preservation requirements

Maintain the building site in line with above requirements to ensure that:

- ☐ building envelope materials and/or components are protected against deterioration at all stages of construction
- ☐ the condition of building envelope materials and/or components may be periodically assessed
- ☐ building envelope materials and/or components stock rotation should be maintained, where applicable
- ☐ building envelope materials and/or components packaging and preservation methods should conform to contractual agreements and provide proper protection against damage and/or environmental conditions
- ☐ building envelope materials and/or components handling instructions will be followed
- ☐ preparation of the building envelope materials and/or components for inspection is completed

4.10.2 Responsibility

- ☐ Responsibility for protection of the product against damage or deterioration rests with all personnel of the Builder involved in project management and building envelope construction activities.

The Site Superintendent and Builder's Quality Management Representative (QMR) are directly responsible for compliance with practices related to the building frame materials and/or components handling, storage, packaging, preservation and delivery.

4.10.3 Handling³

- ☐ Handling of building envelope materials and/or components is performed in such a way that quality is protected against damage and deterioration at all stages of building envelope construction, from the receipt of building and installation materials to commissioning. This includes product protection during loading, unloading, and transportation of any kind at the building site.
- ☐ The Contractor shall comply with guidelines provided in this Quality Manual, related procedures, and instructions or warnings required by applicable regulations. Handling

requirements and standards shall be considered in conjunction with operators training, including forklift / crane operators training, and applicable regulations.

The methods of handling applicable to building envelope materials and/or components should provide for correct use of handling equipment and accessories to prevent damage due to excessive stresses, vibration, shock, abrasion, corrosion, environment or any other conditions occurring during handling. These requirements shall specifically address correct use of handling means available at the building site such as trucks, conveyors, cranes, forklifts, elevators, etc.

4.10.4 Storage

Building envelope materials and/or components shall be stored in designated storage areas, in a manner that ensures:

- ☐ no product damage or deterioration may occur due to the storage / environmental conditions
- ☐ condition of the stored product is assessed periodically
- ☐ receipt and dispatch of building envelope materials and/or components is authorized and documented

- ☐ A documented system for the receipt of incoming building envelope materials and/or components is established, put into use and maintained. See also Receiving Inspection, Section 4.10.2 of this Manual.
- ☐ Appropriate storage methods suitable for conditions applicable to specific building site should be specified to avoid deterioration of building envelope materials and/or components.
- ☐ Storage conditions and the condition of product in stock should be checked periodically to detect as early as possible any symptoms of product loss, damage or deterioration.
- ☐ Items with limited shelf life or requiring special protection during storage should be identified. This requirement applies in particular to all building envelope materials and/or components with limited shelf life such as paints, resins, glues, sealants, fillers, etc. stock rotation based on first-in-first-out principles is implemented and maintained for such items whenever practical.

Unfortunately, many manufacturers do not wish to emphasize "Best Before" information . It therefore behooves the Builder's QMR to re-label boldly such information.

4.10.5 Packaging

- ☐ Building envelope materials and/or components shall be marked according to documented guidelines to enable their prompt identification and use in required sequence at applicable building envelope or components assembly stages.

As a practical example of this, Simpson Strong Tie Ltd., manufacturer of fasteners and seismic restraints for wood frames, labels each incoming order of steel (after an exhaustive receiving inspection) with the product(s) that steel is destined to be used for. Thereafter it becomes very difficult to misuse the material. Drywall suppliers often label the sides of drywall pallets with the suites they are intended for. It is not unreasonable for Builders to insist on similar packaging efforts generally.

4.110.7 Preservation

- ☐ Protect building envelope materials and/or components owned by the Builder, its Customer or Supplier / Subcontractor against the possibility of deterioration or damage, when in safekeeping at the building site supervised by the Builder.

The preservation methods which apply to building envelope materials and/or components at building site include

- ☐ suitable packaging of purchased or Customer-supplied product,
 - ☐ moisture or water damage elimination,
 - ☐ cushioning, supporting, strapping, blocking, crating,
 - ☐ use of tarpaulins, and
 - ☐ other methods, as deemed appropriate.
-
- ☐ Take immediate corrective steps when an unacceptable degree of product quality deterioration is identified or foreseen.

4.10.6 Delivery

- ☐ The Builder shall ensure readiness of the partially completed building envelope. A building envelope segment awaiting pre-delivery inspection shall be properly prepared and adequately protected against damage until such a time as its quality has been reviewed, and until the responsibility of the Builder for the building envelope has ceased in line with the terms and conditions specified in contractual agreements.

4.10.7 Handling, Storage, Packaging, Preservation and Delivery: Records

Records related to Handling, Storage, Packaging, Preservation and Delivery shall be maintained.

Item	Name	Responsibility
1./	Receiving Log	Shipper/Receiver
2./	Building Site Construction Log	Site Supt

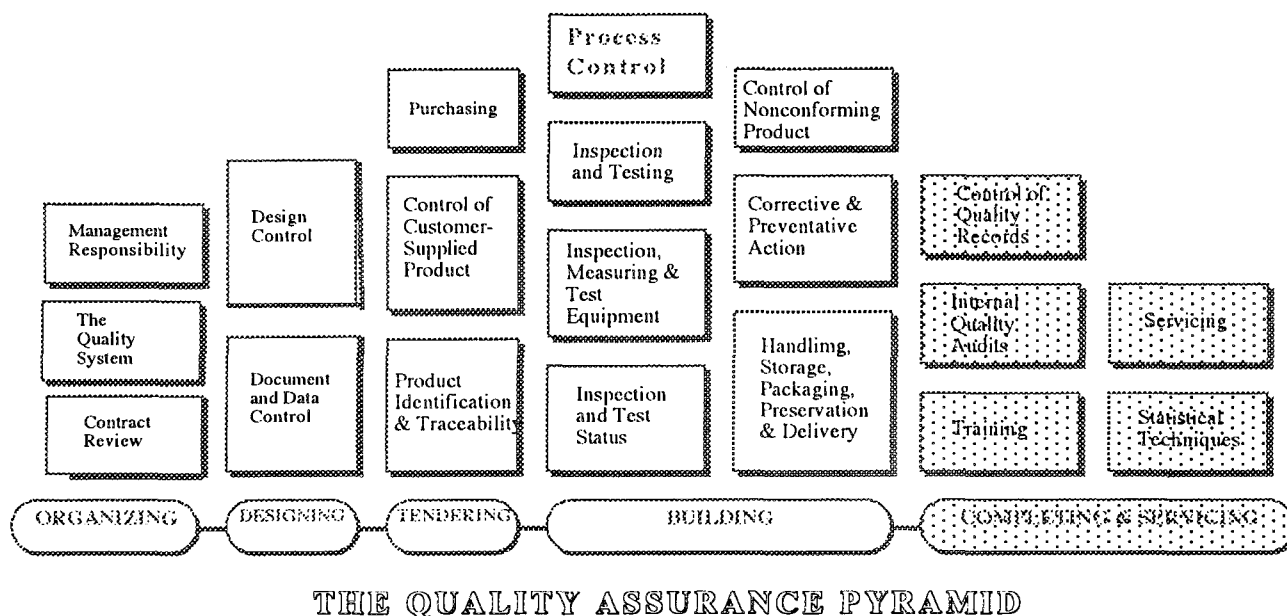
¹ The Building Envelope Reviewer should probably have input to the determination of critical product.

² As is currently the case in Vancouver and New Westminster, with other municipalities leaning in this direction.

³ Everyone's standard specifications include clauses relating to these activities. Unfortunately, most are not followed or enforced. This Section highlights the principles of quality assurance rather than specific wording.

Chapter 5	COMPLETING & SERVICING QUALITY	2
5.1	Control of Quality Records: Introduction	2
Main headings are located at Level 1 and numbered 1.1 and on.		3
Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.....		3
5.1.1	Quality Records: Definition and Purpose.....	4
5.1.2	Quality Records: Responsibility	4
5.1.3	Quality Records: Guidelines.....	4
5.1.4	Quality Records: Retention, Disposal and Availability.....	5
5.1.5	Quality Records: Storage	5
5.1.6	Quality Records: Evidence.....	6
5.2	Internal Quality Audits.....	6
5.2.1	Internal Quality Audits: Introduction	6
5.2.2	Internal Quality Audit: Purpose	7
5.2.3	Internal Quality Audit: Responsibility.....	8
5.2.4	Internal Quality Audit: Procedure	8
5.2.5	Internal Quality Audits: Records	8
5.3	Training.....	8
5.3.1	Training: Introduction	8
5.3.2	Training: Purpose and Policy.....	9
5.3.3	Training: Responsibility	11
5.3.4	Training: Procedure	11
5.4	Servicing	12
5.4.1	Servicing: Introduction	12
5.4.2	Servicing: Purpose.....	14
5.4.3	Servicing: Responsibility	14
5.4.4	Servicing: Procedure	14
5.4.5	Servicing - Records.....	15
5.5	Statistical Techniques	15
5.5.1	Statistical Techniques: Introduction.....	15
5.5.2	Statistical Techniques: Purpose.....	16
5.5.3	Statistical Techniques: Responsibility	17
5.5.4	Statistical Techniques: Guidelines	17
5.5.5	Statistical Techniques: Records.....	18

Chapter 5 COMPLETING & SERVICING QUALITY



5.1 Control of Quality Records: Introduction

The need for properly maintained quality records is obvious. The Builder is expected to maintain evidence which demonstrates that a building envelope meets quality requirements, and that the quality system is operating effectively. If there is a need for the Builder to show that specific activities were performed, that required information has been recorded or that an outcome of activities has been met, these are the records which will provide required evidence.

The guidelines for collecting, storage, retrieval, retention, and disposition of records need to be defined. These guidelines shall be followed at the building site and at any other place where objective evidence of building envelope quality is generated (i.e. pertinent quality records from the subcontractor may constitute an element of these data).

Records may be in the form of any type of media, such as hard copy or electronic media. Records shall be legible and shall be stored and maintained in an environment that prevents damage, deterioration or loss.

Quality records shall be retained for a period of time which reflects needs of specific contract and/or supports evidence sought by applicable building code practices. Where agreed contractually, access to quality records shall be granted to the customer or the customer's representative for an agreed period.

The following are examples of the types of quality records requiring control: inspection records, test data, pre-occupancy completion / commissioning reports, design review and

verification reports, material certificates (Certificates of Compliance), equipment calibration data, etc. The records, which give evidence that the building envelope or its specific stage has passed inspection and/or test within defined acceptance criteria, are of particular importance. The end of every section of this Quality Manual contains a requirement for specific quality records providing support for the quality system defined below.

This document is written in Microsoft Word 98 for MacIntosh as a Rich text Format (RTF) document. This means that formatting will remain when the document is imported to a PC version of Word.

Preserving the formatting is important, because it makes extensive use of Word's outlining function, as follows:

Main headings are located at Level 1 and numbered 1.1 and on

Sub headings are located at Level 2 and numbered 1.1.1 and on. If a user deletes one or more subheadings or headings, the document can be renumbered to avoid gaps.

- ☐ Checklist box typical - NOTE: Throughout this Quality Manual, check boxes such as this one are inserted wherever a quality assurance element should be "ticked off."
- ☐ By collapsing the outline to Level 3 and up, all subsequent data will be hidden and the user will have a simple checklist, which can be expanded at any point if backup material is needed. The checklist format can be printed as a stand alone document, or with the backup information

Q-Tips - are suggestions, tricks, and experiences which may assist in the application of the Quality Assurance Protocol are inserted where appropriate in this Chapter in the form of ***Q-Tips*** - comments enclosed in boxes like this one.

Printing or viewing the document from Level 4 and up will provide the full checklists plus associated Q-Tips.

Text located at outline level 5 or below, such as this, becomes visible when the outline is further expanded. In this way, detailed explanations, etc. are available to the user without cluttering the basic checklist and Q-Tip content.

5.1.1 Quality Records: Definition and Purpose

Quality records are defined as those documents demonstrating effects of activities performed by the Contractor:

- ☐ affecting directly or indirectly quality of the building envelope, i.e. project performance, building envelope stage completion, interim inspection and testing, pre-occupancy verification, commissioning reports, etc.

documenting effective operation of the quality management quality system

Records pertaining to quality of the building envelope are represented by (but not limited to) the following:

- ☐ inspection and test records (receiving, in-process and final inspection and testing)
- ☐ purchased products or services certificates of compliance
- ☐ Corrective Action Requests (if any)
- ☐ Pre-occupancy report
- ☐ Building envelope commissioning report

5.1.2 Quality Records: Responsibility

- ☐ The Site Superintendent and, in particular, the Site Foremen are responsible for maintaining control over and ensuring compliance with procedures relevant to the quality records within boundaries of their authority and responsibility.
- ☐ The Contractor's Quality Management Representative (QMR) is responsible for setting up and maintaining quality records, as outlined in the relevant Sections of the Quality Manual.

5.1.3 Quality Records: Guidelines

- ☐ Keep legible, easily identifiable and retrievable Quality records.
- ☐ Demonstrate in Quality records whether the building envelope or its specific stage has passed or failed defined inspection and test criteria (including evidence of non-conforming building envelope control, where applicable). This requirement applies

directly to the quality of project management activities as well as to the quality of building envelope controlled by these activities.

- ☐ Maintain traceability of the quality records, in order to provide:
 - ☐ evidence of building envelope compliance with customer requirements, building codes and specifications
 - ☐ documented disposition of non-conforming building envelope
 - ☐ adequate and objective proof of the quality system effectiveness

The Quality Assurance Representative or delegate are the only personnel within the Builder's organization authorized to release the building envelope of its specific stage or to sign-off completion of the project stage. Quality records shall reflect this authority.

5.1.4 Quality Records: Retention, Disposal and Availability

- ☐ Unless specifically required otherwise quality records providing evidence of the building envelope quality and compliance with related building codes, practices and regulations shall be retained for a minimum period of 10 (ten) years.¹
- ☐ No record of disposal after ten years is required, however, at the Contractor's discretion, obsolete quality records may be retained for an extended period of time and/or the Contractor may establish a documented evidence (list) of disposed records.

5.1.5 Quality Records: Storage

- ☐ Quality records shall be stored in a suitable environment and maintained in a manner:
 - *protecting stored records against deterioration or damage*
 - *ensuring access to the records by authorized personnel only*
 - *providing continuity and traceability of stored information/data*

¹ This is becoming the standard for building envelope warranties.

Q-Tip - Electronic quality records (i.e. computer disks, laser discs or magnetic tapes) shall be:

- stored and maintained far from sources of magnetic or electrostatic field
- protected against deterioration and/or damage i.e. high temperature, humidity, etc.
- properly described and identified to enable their easy traceability and retrieval
- maintained by authorized personnel only, with restricted access to areas containing sensitive information and appropriate computer skills to prevent accidental data loss
- records stored directly on computer's data storage facility, i.e. mainframe, network/server or individual computers, shall be duplicated/backed-up at regular intervals in order to minimize loss of stored data in a case of computer failure. Backup tapes or disks shall be stored according to the above guidelines, preferably at a different and secure location, i.e. at home, at different building site or at Contractor administration office.

Quality records shall be reviewed periodically in order to assess their storage condition and prevent premature deterioration and loss of valuable data.

5.1.6 Quality Records: Evidence

- ☐ Maintain Quality Records (as defined in applicable Sections of this Manual) As nominated in relevant Sections of the Quality Manual

5.2 Internal Quality Audits

5.2.1 Internal Quality Audits: Introduction

Purpose of this Section - All the elements of a Building Envelope Provider's quality system should be internally evaluated on a regular basis. This quality system evaluation process is commonly referred to as Internal Quality Audits. An Internal Quality audit is in essence a simple check to see if the Building Envelope Provider follows the fundamental ISO 9000-series principles "say what you do, do what you say, and prove the above".²

Quality Manual Approach - Internal Quality Audits are one of "planned" quality system activities" and an appropriate Internal Quality Audit Plan (Schedule) should be established by for their purpose. The format of the Internal Quality Audit Plan should define the specific areas to be audited and nominate the personnel carrying out audits.

² We are advised by a recently ISO 9001 certified engineer in Vancouver that the initial audit examined 100% of their processes, requiring 3 days to complete. Subsequently, 20% at random of procedures are audited each 6 monthss, meaning the entire quality system is reviewed over a 3 year cycle.

In order to eliminate possibly biased opinions, the quality system elements shall be evaluated by personnel familiar with ISO 9001 requirements and independent of the specific activities or areas being audited.

Audit non-compliance or deficiencies identified during Internal Quality Audits should be documented and submitted for consideration by the company management. Reported discrepancies (if any) shall be reported and corrective action shall be taken in line with Section 4.14 of this Manual.

Values of this Section - Properly structured and implemented Internal Quality Audits are a powerful tool that can be used by the Building Envelope Provider to monitor their quality system. Not only their results provides Building Envelope Provider management with valuable information about how effectively their quality system works but they also offer an opportunity for further improvement which leads competent management towards increased competitiveness and financial gains.

In very simple terms it is extremely wasteful to have a "quality system" which does not work. Such a system is not only costly in monetary terms but also it also becomes a source of continuous frustration of Contractor's personnel.

5.2.2 Internal Quality Audit: Purpose

To ensure that the quality system defined in this Quality Manual and implemented by the Contractor is effective, and that identified discrepancies (if any) are corrected in a timely manner.

- ☐ The Quality Representative shall conduct internal Quality Audits of the Building Envelope Provider quality system. Their findings shall be reported to the Building Envelope Provider's senior management as a part of the Management Review process.

Polygon keeps a running tally for all of its projects of deficiencies observed at "orientation", which is when a purchaser and Polygon staff do a detailed review prior to the purchaser moving in. The number of deficiencies by project is compared to other projects and to the total number of orientations on a weekly basis, in part to monitor ongoing quality of the delivered product.

Orientation inspections become an addendum to the possession certificate at Polygon, ensuring that the repair of observed deficiencies is part of the sales contract.

Polygon also conducts homeowner questionnaires after occupancy, in order to obtain customer feedback on their efforts.

5.2.3 Internal Quality Audit: Responsibility

- ☐ The Building Envelope Provider Quality Representative and/or authorized Building Envelope Provider personnel independent of those having direct responsibility for the audited area is responsible for conducting Internal Quality Audits.
- ☐ The Building Envelope Provider personnel with responsibility for the audited area(s) shall assist auditing personnel in conducting Internal Quality Audits and take timely corrective and/or preventive action on discrepancies found during the audit

5.2.4 Internal Quality Audit: Procedure

Authorized Building Envelope Provider personnel shall:

- a) perform Internal Quality Audits according to the Internal Quality Audit Plan
- b) ensure that quality system, as defined in this Manual and related procedures, is followed and effective
- c) identify discrepancies are reported to the Building Envelope Provider senior management.

ensure corrective and/or preventive action is taken in regard to identified discrepancies (if any)

- ☐ Internal Quality Audits shall be documented on Internal Quality Audit Reports.

5.2.5 Internal Quality Audits: Records

- ☐ Internal Quality Audit records, as defined in this Manual shall be maintained. Evidence shall be provided that quality system activities and that reported results comply with guidelines of this Quality Manual and related instructions.

5.3 Training

5.3.1 Training: Introduction

Quality Manual Approach - Building Envelope Providers shall consider training all levels of personnel within an organization. Increased attention should be given to the selection and training of newly recruited personnel and personnel transferred to new assignments.

Training should provide:

- ☐ executive management with an understanding of the quality system.
- ☐ technical personnel with explanation of their contribution to the success of the quality system.
- ☐ site superintendents and building workers with guidelines regarding the methods and skills required to perform their tasks, i.e. operation of instruments, tools, and machinery they have to use, reading and understanding the documentation provided, the relationship of their duties to quality, and safety of the workplace.

Whenever appropriate, personnel should be certified in specialized operations such as welding, inspection, installation work, etc. Beyond completion of formal training programs or education, consideration should be given both to experience and demonstrated skills.

Training program need to be first defined, then followed. Training programs address identified training needs although the range of skills and knowledge which is required varies according to circumstances and the individual's role in the organization. Where appropriate, competence and skills should be demonstrated by examination, certification or testing/verification either in-house or by a recognized outside party.

A properly designed training program for building site personnel should:

- ☐ reflect the interchangeability of trained personnel to satisfy the company's needs.
- ☐ include housekeeping, safety, reporting, etc. as required.
- ☐ ensure that quality policy is understood at all levels of the organization.

Training records, including achievement of required skill levels should be maintained.

5.3.2 Training: Purpose and Policy

This procedure defines a Building Envelope Provider's policy with regard to the training of personnel who provide labour and services on a building site .

- ☐ The Building Envelope Provider' shall ensure that the knowledge and skills of personnel performing activities affecting quality meet internal company needs as well as customer requirements and expectations.

The Building Envelope Provider' conducts training of employees aimed at:

- a) maintaining specified standards of quality
- b) maximizing use of available skills, experience and expertise
- c) improving the availability of personnel with interchangeable capabilities

5.3.3 Training: Responsibility

- ☐ For a Builder, it shall be the responsibility of the Site Superintendent to ensure compliance with this procedure. For other Building Envelope Provider's, the QMR shall have this responsibility.

The Site Superintendent, within the area of authority, shall ensure that:

- a) training requirements for supervised personnel are identified
- b) the QMR is informed about identified training needs
- c) interchangeability of the personnel is established and maintained

training and skills records are maintained

- ☐ Authorized building site administration personnel shall convert identified training requirements into suggested training program(s), and monitor these programs within allocated finances. The Site Superintendent should also be responsible for review and endorsement of training program(s) and for allocation of adequate funds for training purposes.
- ☐ A Training Program is required for all employees, including managerial and technical staff, as appropriate.

5.3.4 Training: Procedure

- ☐ Adequate resources shall be allocated to ensure that Company training needs are met, as planned.
- ☐ Assessment of training needs shall address employee interchangeability. Availability of trained personnel equipped with interchangeable skills shall ensure that there are always personnel equipped with appropriate skills to reduce the impact of temporary shortages in human resources at the building site. The Site Superintendent shall maintain a list of qualified personnel and subcontractors who may provide additional qualified human resources in such circumstances.
- ☐ Contract employees shall complete Introduction Training program providing information about the Company, with specific emphasis on its quality system. Skills of personnel delegated to perform specific duties shall be qualified on the basis of possessed education, training and/or experience.
- ☐ Identified training needs shall be documented in personnel training records, summarized on Personnel Skills Inventory records, and reflected in the Contractor's Training Program.
 - Q-Tip - The Project Post Mortem** - At the end of a project, various team members (if they are still speaking to each other) will often "let their hair down" a bit, perhaps muse over a few beers about what might have been done better. Such sessions can remain informal and relaxed, yet capture important lessons usable on the next project. The lessons may have particular application to certain procedures or personnel, or may be general. But they should be captured, either as Q-Tips or actual modifications to the Quality Manual.5.3.5 Training: Records
- ☐ The following records shall be maintained:

I.	Document	Responsibility
1./	Personnel Training Records	Building Site Administration
2./	Training Program	Site Superintendent
3./	Personnel Skills Inventory	Building Site Administration

5.4 Servicing

5.4.1 Servicing: Introduction

Introduction - ISO 9001; 1994 in Section 4.19 states "Where servicing is a specified requirement, the supplier shall establish and maintain documented procedures for performing, verifying and reporting that the servicing meets the specified requirements". Notwithstanding that ISO requires it, common sense demands servicing become a part of the approach to each Project. The CMHC Building Failures study pinpointed poor maintenance or lack of maintenance as a contributing factor to some building envelope failures.

Key Concepts -

- ☐ If a Building Envelope Provider's obligation defined in contractual agreement include guarantee or warranty of the building envelope, then ISO 9000-series requirements related to servicing are applicable.
- ☐ This requirement may be extended even further if the Building Envelope Provider' is committed by regulations/legislation to provide service in any form i.e. installation, commissioning, after-sales service, warranty repairs etc.

Quality Manual Approach - This Section of the Quality Manual may be applied to both internal and external services of the Building Envelope Provider. The nature of the services provided is defined as follows:

- ☐ A service which is subject to customer evaluation
- ☐ The process by which the service is delivered to the end user

Post-commissioning warranty for a building envelope shall confirm assurances regarding timely repair of defects which become known after the building completion.

Whenever applicable, the following guidelines shall be considered:

- ☐ customer needs in regards to building envelope post-commissioning services shall be identified and documented
- ☐ the nature and extent of required services shall be clearly defined and constitute part of the contractual agreement
- ☐ responsibility for servicing should be clearly defined and information regarding where to lodge complaints related to the building envelope warranty shall be provided
- ☐ a simple procedure for reporting and handling warranty complaints shall be established
- ☐ adequate resources shall be secured for warranty / servicing purpose. Response to this requirement may take form of alternative arrangements made by the Contractor with subcontractors specializing in such services.
- ☐ personnel involved in servicing activity shall be adequately trained

- ☐ records of service / warranty activities shall be maintained

Value of this Section

Requirements of this ISO 9001 Section may not apply to a Building Envelope Provider whose products do not fall into the coverage by guarantees or warranties. Defining what are "specified requirements" which trigger applicability of this Section may be an eye-opening exercise.

5.4.2 Servicing: Purpose

The purpose of these procedures is to ensure that, whenever contractually required, service activities provided by the Contractor :

- a) are performed according to the documented procedures
- b) meet contractual requirements

- ☐ The procedures apply to all technical support activities related to the building envelope warranty.

5.4.3 Servicing: Responsibility

- ☐ The Building Envelope Provider's Quality Management Representative (QMR) with responsibility for warranty shall be directly responsible for quality, efficiency and adequacy of service to the building envelope provided under terms and conditions specified in contractual agreement.

5.4.4 Servicing: Procedure

- ☐ It is the policy of the Building Envelope Provider' that all warranty-related activities provided by the Building Envelope Provider' or its authorized service outlets shall follow the guidelines defined in this procedure.
- ☐ The Building Envelope Provider' may delegate responsibility for service to a selected and approved sub-contractor familiar with the specifications, quality practices and procedures applicable to building envelope.

Q-Tip - Suitability of any Subcontractors engaged by the Building Envelope Provider' to carry out warranty services should be evaluated and this information included on the Approved Suppliers List . This may be a subcontracted service (and a very important one) for which the Building Envelope Provider will carry full responsibility, therefore selection of a suitable Subcontractor is critical from the point of view of future warranty performance and customer satisfaction (or lack of it).

- ☐ The Building Envelope Provider' management shall periodically review Service activities and relevant records.

Q-Tip - - KEEPING TRACK OF WARRANTY DATES - The cover page of any maintenance manuals should include a simple to read table with warranty expiry dates for various building envelope elements noted on it.

Q-Tip - BUILDING MAINTENANCE MANUAL OR CAR MAINTENANCE MANUAL - WHAT'S THE DIFFERENCE? Most automobiles come with a clear table of maintenance requirements required after certain mileages or ages. From the auto world we also have the concepts of spring tune-up and winter tune-up. There is no reason building envelope maintenance manuals could not have similar maintenance tables and suggestions for regular "tune-ups."

- ☐ Whenever defined in contractual agreement, servicing activities shall meet specific customer requirements and agreed building envelope Warranty Terms and Conditions.

Q-Tips - IDENTIFYING HIGH MAINTENANCE ITEMS - This may be a tricky item in the context of liability. Section 4.4 "Designing for Quality" has suggested identifying where selected details/materials vary from Best Practice Guide recommendations. This may provide a clue to items more likely to be high maintenance. But high maintenance should not automatically be seen as wrong - many traditional designs with enduring appeal exhibit high maintenance details and/or materials. On balance, we believe it is better to identify items/areas needing more or more frequent attention - the alternative may be a leaky building envelope. If such items have been identified and accepted at the design stage, then their identification should endure to this phase of a Project, meaning that most servicing issues will have already been identified and addressed.

5.4.5 Servicing - Records

- ☐ The following records shall be maintained:

Item Name	Responsibility
1./ Warranty Records Quality Management Representative	The
2./ Warranty Terms & Conditions Quality Management Representative	The

5.5 Statistical Techniques

5.5.1 Statistical Techniques: Introduction

Use of statistical techniques in modern quality systems is compulsory (it is NOT one of these requirements, which start from words “where appropriate”. Statistical techniques are required to “...*establish, controll and verify process capability and product characteristics...*”.

A typical building site, and the process of constructing a building envelope in particular, has very limited need for the use of statistical techniques. Verification of product characteristics is a different matter and some simple statistical methods should be applied. Additionally, Designers may find a need for the use of more sophisticated statistical techniques for environmental tests (rain, moisture content, wind, earthquake, erosion, etc.), building mockup tests, communication (traffic, pedestrians, etc.), noise and magnetic field evaluation or analysis of statistical data related to durability and reliability of mechanical components of the designed buildings (escalators, elevators, gensets, etc.).

There is a wide choice of available statistical techniques ranging from simple data collection sheets to complex capability studies, failure mode analysis methods and exercises in the design of experiments. The decision which one will be the most suitable from the Building Envelope Provider’s point of view is an important one and should be taken with a lot of thought, as it usually triggers serious demands for resources and its effects may have broad legal and financial implications.

Correct application of statistical techniques should be extended to the post-construction (post-commissioning) stages and may be used for purposes such as: market analysis, determination of quality levels, inspection data analysis, safety evaluation, risk analysis, project performance monitoring and assessment, etc.

In general, the building envelope Contractor is expected to ensure proper selection and effective use of suitable statistical techniques for the verification of conformance of the product.

The use of control charts and statistical sampling plans are examples of techniques employed to facilitate Statistical Process Control.

5.5.2 Statistical Techniques: Purpose

The purpose of this procedure is to define the selection and use of selected statistical techniques suitable for verifying conformance of the building envelope quality to specified requirements.

Statistical techniques selected by the Contractor are used for:

- a) *construction / project progress monitoring*
- b) *inspection activities at defined stages of building envelope construction*
- c) *investigation of the Corrective Action Requests*

d) *monitoring of quality performance*

5.5.3 Statistical Techniques: Responsibility

- ☐ The Quality Management Representative shall:
 - a) identify need for use of statistical techniques, their selection and implementation
 - b) collect and, where appropriate, analyze gathered statistical data
 - c) communicate results of statistical analysis
- ☐ The Site Superintendent shall ensure that:
 - a) all personnel utilizing statistical techniques (i.e. checksheets) are trained in their use
 - b) whenever required, assistance is provided to the Quality Assurance Department in gathering statistical data
 - c) adequate resources are allocated for training of the personnel in selected statistical techniques.

5.5.4 Statistical Techniques: Guidelines

Q-Tip - A Note about Technique - Statistical techniques vary from very simple to very complex. The Contractor should use “horses for courses” criteria to select statistical techniques which are the right ones for specific project. This selection may vary from project to project depending on unique needs of specific work.

The most sophisticated statistical techniques are not necessarily the best and, if incorrectly selected, may create circumstances when valuable resources are wasted. It will be safe to assume that, unless specific project needs dictate otherwise, simple checksheets (i.e. inspection or work progress checksheets), simple diagrams (histogram, bar graph, line graph), and simple data collection sheets (i.e. log books) will be the most suitable ones and will most likely address the basic needs of typical Building Envelope Provider. It has to be remembered however that even these simple techniques need instructions and training in their use. Otherwise all effort in their implementation and dedicated to statistical data collecting will be wasted.

- ☐ The statistical techniques noted below are selected for building envelope quality verification purposes:

Techniques:

Applications:

- | | |
|---|--|
| a) Diagrams
progress, supplier, etc.) | Performance monitoring (project |
| b) Data collection sheets
monitoring | Receiving inspection, corrective action progress |
| c) Inspection Check Sheets
completion, commissioning | Inspection and test, quality audits, work |

5.5.5 Statistical Techniques: Records

☐ The Quality Assurance Department shall maintain the following records, either manual or electronic:

I Document

Responsibility

a) *Inspection Check Sheets*
Quality Management Representative

Construction Personnel /

b) *Data Analysis Records*
Representative

Quality Management

Quality Assurance Protocol Test Drive by CMHC & Polygon Construction Ltd.		QUALITY PLAN - Date revised: October 17, 2000 Project Name: 5 th Ave. and Cypress St., Vancouver Project Address: ditto Customer Name: Polygon Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8 Customer Tel/fax/e-mail: 877-1131/ 876-7610 Customer QM Rep.: Al Waring QM Rep. tel/ fax/ e-mail as above								
Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

1.1 ₁	Management Responsibility ²	Due ³	Done ⁴	C ₅	D ₆	GC ⁷	1 ⁸	2 ⁹	3 ¹⁰	4 ¹¹
1.1.1	Quality Policy (QP)			12						
	Develop Company wide QP ¹³		X							
	How is Quality policy refined? ¹⁴ x		X ¹⁵							
	Develop Project QP ¹⁶									
1.1.3	Organization									
	Appoint Company wide QMR ¹⁷		X							
	Appoint Project QMR ¹⁸		X							

¹¹ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

² Footnotes which are particular to this test drive are shown in bold type like this. Additions to the "Responsibility" column of the Quality Plan which are derived for this test drive experience are also in bold type.

³ Insert any known "Due" date in this column as a reminder

⁴ "Done" can be checked off or initialed when complete, as appropriate

⁵ C = Customer: Al Waring, Vice President, Construction, Polygon

⁶ D = Designer: Nigel Baldwin, Nigel Baldwin Architects

⁷ GC = General Contractor: Al Waring, Vice President, Construction, Polygon

⁸ 1 = [QM Rep. Name/contact info] _____

⁹ 2 = [QM Rep. Name/contact info] _____

¹⁰ 3 = [QM Rep. Name/contact info] _____

¹¹ 4 = [QM Rep. Name/contact info] _____

¹² Insert here an indication as to who has direct responsibility for a phase/step, and who is a contributor. For example, direct responsibility might be a 4 mark, a contributor might be an X

¹³ Ideally, the company wide Quality Plan (QP) is based upon a Quality Manual. Polygon has a document entitled "Quality is Free", consisting of checklists, specifications, etc., used for its projects. This has been identified as Polygon's company wide quality plan. It consists of a short introductory comment together with Polygon's selection and installation requirements for a variety of materials and systems it uses on its projects. It is not a quality manual in the sense recommended by the QAP, but is more extensive than for other developer/builders we are familiar with.

¹⁴ At the bottom of each page of Polygon's "Quality is Free" manual are locations for 3 sets of initials, representing the Vice Presidents of Development, Construction and Quality Assurance. Each revision to the Quality Manual requires approval by these 3 key players, implying "buy-in" by all departments of the company.

¹⁵ Quality policies are refined at Polygon through periodic brainstorming sessions between Development Managers and Construction Managers. These sessions are scheduled in response to feedback from staff and purchasers from completed and in-progress projects.

¹⁶ The Project QP is this document. As this is a test drive, this Quality Plan will not be implemented on this project, rather will be refined as the project's evolution suggests.

¹⁷ [QM Rep. Name/contact info] = Al Waring, Vice President, Construction

Quality Assurance Protocol Test Drive by CMHC & Polygon Construction Ltd.		QUALITY PLAN - Date revised: October 17, 2000 Project Name: 5 th Ave. and Cypress St., Vancouver Project Address: ditto Customer Name: Polygon Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8 Customer Tel/fax/e-mail: 877-1131/ 876-7610 Customer QM Rep.: Al Waring QM Rep. tel/ fax/ e-mail as above							
Ref.	Responsibility	Due	Done	Responsible Parties					
				C	D	GC	1	2	3

	Advise Customers of any QMR Changes									
1.1.4	Management Review									
	Describe the management review system for Polygon's overall quality implementation system ¹⁹		x ²⁰							

¹⁸ [QM Rep. Name/contact info] = Al Waring, Vice President, Construction. NOTE: Polygon might delegate the Project QMR ordinarily, but in this case a combination of a slower economy and a desire to have senior involvement in the test drive lead to the nomination of Mr. Waring.

¹⁹ May involve interviews with other staff.

²⁰ Polygon has weekly operations meetings at which each project is reviewed, including quality aspects. Part of the input to these meetings is questionnaires from purchasers, whose comments on quality are taken as the basis for proposed design and construction refinements. Quality Managers also perform regular in-process inspections to review quality.

Quality Assurance Protocol Test Drive by CMHC & Polygon Construction Ltd.		QUALITY PLAN - Date revised: October 17, 2000 Project Name: 5 th Ave. and Cypress St., Vancouver Project Address: ditto Customer Name: Polygon Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8 Customer Tel/fax/e-mail: 877-1131/ 876-7610 Customer QM Rep.: Al Waring QM Rep. tel/ fax/ e-mail as above							
Ref.	Responsibility	Due	Done	Responsible Parties					
				C	D	GC	1	2	3

1.2 ²¹	Quality system	Due ²²	Done	C ²⁴	D ²⁵	GC ²⁶	1 ²⁷	2 ²⁸	3 ²⁹	4 ³⁰
1.2.1	GENERAL ³¹									
	Prepare Project Quality Manual		X							
1.2.2	Name Project QMR		32							
1.2.3	Prepare Overall Quality Plan		33							
	Is there a statement(s) covering the expected performance of all Polygon projects - longevity, durability, etc.		X ³⁴							
1.2.4	Prepare Project Quality Plan		35							
	Is there a statement(s) covering the expected performance of the project - longevity, durability, etc.		36							

²¹ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

²² Insert any known "Due" date in this column as a reminder

²³ "Done" can be checked off or initialed when complete, as appropriate

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³¹ Each Building Envelope Provider should develop this column of entries consistent with its detailed design practices. This particular layout reflects a company with some design responsibility, i.e., working drawings, shop drawings, etc. It is in draft form and may not reflect all of the content of Section 4.4 as yet.

³² Assumed to be Al Waring.

³³ See notes above

³⁴ Al Waring advises this is a subject which has not been studied by the company.

³⁵ see notes above

³⁶ see notes above

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

1.3 ³⁷	Contract review	Due ³⁸	Done	C ⁴⁰	D ⁴¹	GC ⁴²	1 ⁴³	2 ⁴⁴	3 ⁴⁵	4 ⁴⁶
1.3.3	General assessment of capabilities at RFP or Invitation to tender stage ⁴⁷		x ⁴⁸							
	Has a QMR been nominated for each Designer/ Builder/ Supplier/ Installer?		x ⁴⁹							
	What are the established channels for communication on the project? ⁵⁰		x ⁵¹							
1.3.3	Contract Procedure									
	Pre-Bid activities									
	How are tender packages scoped?		x ⁵²							

³⁷ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

³⁸ Insert any known "Due" date in this column as a reminder

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⁴⁰ C = Customer:

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⁴⁸ Polygon's assessment is based upon its knowledge of tenderers' finances, current activity, etc. There is no firm formula. Al Waring advises the marketplace changes too quickly for meaningful record keeping/

⁴⁹ Al Waring advises each DBSI has a defined contact for matters of quality.

⁵⁰ These should be recorded right in the Quality Plan.

⁵¹ On Polygon projects, Trades meet weekly to address various matters, including quality issues. The site supt., Construction Manager and Development Manager meet weekly with an agenda which includes consultant coordination, addressing To-Do lists, etc.

⁵² A sample Polygon trade contractor work scope has been obtained and is being evaluated for refinements to Section 3 - Purchasing

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	Are envelope components handled separately, or is each finishing trade responsible for all of their substrate conditions? ⁵³		x ⁵⁴							
	Resolved differences									
	How are amendments to design and construction documents documented ⁵⁵		x ⁵⁶							
1.3.5	Project records									
	How are Contract review records maintained ⁵⁷									
	Pre-Bid/Bid									
	Contract									
1.3.7	Quality/Cost Balancing									
	Who is nominated within the Owner's organization to resolve any apparent Quality/Cost conflicts or issues? ⁵⁸		59							

⁵³ Industry seems to be going in 2 directions - either one crew is responsible for, say, all sheathing paper and peel & stick, or each finishing trade subcontractor is responsible for the substrate down to the plywood/OSB sheathing.

⁵⁴ Polygon has one trade especially retained to construct the sheathing/substrate wall conditions. They find this is more successful than having various finishing trades, whose expertise is primarily in finished materials, prepare substrates. The interfaces between various finish materials are particularly problematic.

⁵⁵ Refer to the Quality Manual, 1.3.4, Tab 1, p. 11 for a list of some criteria which pertain. Indicate exactly how amendments arising from DBSI reviews are incorporated before contracts are signed or during construction.

⁵⁶ Polygon advises most design amendments are market driven. Mockups are used for design changes as well as technical validation. Changes to approved designs must be signed off by Development Managers and Construction Managers, and the cost of design changes is supposed to be absorbed by the initiators (i.e., the design/ marketing people). Conversely, any changes resulting from code changes or on site errors are the responsibility of the construction managers' budgets.

⁵⁷ Includes initial scoping documentation/ RFP's, amendments prior to contract signing, during design development and during construction.

⁵⁸ Refer to the Quality Manual, Item 1.3.7, Tab 1, p.12

⁵⁹ At Polygon, these issues are resolved during the design development stage in periodic meetings involving the design team, the Development Manager, the prospective site superintendent, the Construction Manager, the Quality Assurance Manager and in some cases the Vice Presidents of these functional areas.

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	Who is nominated within the Designer's organization to resolve any apparent Quality/Cost conflicts or issues? ⁶⁰		61							
	Who is nominated within the Builder's organization to resolve any apparent Quality/Cost conflicts or issues? ⁶²		63							
	Who is nominated within the Supplier's organization to resolve any apparent Quality/Cost conflicts or issues? ⁶⁴		65							
	Who is nominated within the Installer's organization to resolve any apparent Quality/Cost conflicts or issues? ⁶⁶		67							
	Have apparent anomalies been resolved? ⁶⁸									

⁶⁰ Refer to the Quality Manual, Item 1.3.7, Tab 1, p.12. Should be logged for each design consultant.

⁶¹ In this case, the Principal of the architectural firm makes the final decisions.

⁶² Refer to the Quality Manual, Item 1.3.7, Tab 1, p.12. Should be logged for the Contractor if different than the Owner, or if there is a different authority for the building arm of the Owner.

⁶³ Polygon is a Developer/Builder, see footnote above.

⁶⁴ Refer to the Quality Manual, Item 1.3.7, Tab 1, p.12. Should be logged for each Supplier

⁶⁵ Polygon advises this is typically the President of the Supplier company

⁶⁶ Refer to the Quality Manual, Item 1.3.7, Tab 1, p.12. Should be logged for each Installer.

⁶⁷ Polygon advises this is typically the President of the Supplier company

⁶⁸ These should be listed right here. also how they were resolved.

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

2.1 ⁶⁹	Design Control	Due ⁷⁰	Done	C ⁷²	D ⁷³	GC ⁷⁴	1 ⁷⁵	2 ⁷⁶	3 ⁷⁷	4 ⁷⁸
	GENERAL ⁷⁹									
	Identify who provides liaison with the Project Quality Plan		80							
2.3	DESIGN PLANNING									
	Creation of Design Plan - Determining project delivery method ⁸¹ - Scoping Building Envelope portion		82							
	What are the communication components of the Design? ⁸³ X Working Drawings Specifications ⁸⁴		85							

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⁸⁰ The Project Architect, Patrick MacLachlan

⁸¹ Project delivery system proposed for this project = DEVELOPER AS BUILDER

⁸² The Project Architect has provided a short summary of building envelope design principles being used on this project, and indicated this is the first time ha has done this.

⁸³ Although traditional components of a design are well known, some owners have their own specifications or standards, which should be identified for review/acceptance by the Designers.

⁸⁴ Refer to the Quality Manual, Tab 2, p. 7, Q-Tip entitled "Outline Specifications" for some thoughts about the nature of specifications.

⁸⁵ The Architect and Engineers all place their specifications in outline form on their drawings. These are a mix of traditional specs. (General/Products/Execution), simple generic or proprietary material selections (application directions unstated) and building code requirements. The feeling is that a separate specifications document is not well enough integrated with the working drawings (i.e., is not read).

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	What is the strategy for communicating design information to the construction site - detail size, keying, etc. ⁸⁶		87							
	Will details involve sequencing recommendations? ⁸⁸									
2.3.1	SCHEMATIC DESIGN									
	What is the story of the Design? ⁸⁹									
	Design Input - Liaison with Customer re Design - Review of programming information - Establishment of basic design concept		90							
	What is the project's water management strategy? ⁹¹		92							
	Schematic Design Output ⁹³									
	Design Review - Comparison with BPG details & recording of variations ⁹⁴		95							

⁸⁶ Refer to the Quality Manual, Tab 2, p. 6 Q-Tip entitled "Timely Details" for some thoughts about developing site usable details.

⁸⁷ It was noted that several of the building envelope design details, while drawn to a traditional 1:8 scale, were nonetheless too small to incorporate the various material sequencing/ lapping information. A scale of 1:5 (metric) or 1:4 would work much better.

⁸⁸ Refer to the Quality Manual, Tab 2, p. 7, Q-Tip entitled "Educational Details" for some thoughts about pro's and con's of sequencing.

⁸⁹ Refer to Quality Manual, Q-Tip under item 2.3.1, Tab 2, p. 5 for a description of this concept.

⁹⁰ In terms of approach to the provision of air barrier, a key building envelope concept, there was no discussion of same until the second major building envelope review meeting, by which time architectural detailing was substantially complete. Two options were discussed, the traditional sealed polyethylene approach and the airtight drywall approach, which Polygon expressed some interest in. The external air barrier approach, similar to Polygon's Santa Barbara project, was not considered, nor was the air barrier sheathing paper approach (Tyvek). It would have been preferable to have these options reviewed at the initial design team meeting, as the extent of detailing completed constrained the selection of options.

⁹¹ That is a series of concepts and details specifically focused on keeping exterior water out while facilitating the removal of exterior water which inadvertently gets inside the building envelope.

⁹² This is somewhat covered in the Project Architect's brief, also somewhat in the Building Envelope Professional's (BEP's) review notes.

⁹³ This line tracks the expected due dates of schematic design output for review.

⁹⁴ It is expected that the Best Practice Guide will become the de facto minimum standard for construction. It will therefore be important to document/justify deviations from the BPG, whether arising from project particulars or DBSI preferences.

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	Design Verification ⁹⁶									
	What elements are used to effect design sign-off at various stages? --- Checklists --- Design Review documents --- Design review meetings --- Other: _____ --- Other: _____		97							
2.3.2	DESIGN DEVELOPMENT									
	Selection of engineering systems	98								
	What bldg. Envelope performance criteria are considered in engineering system selection? ⁹⁹		100							
	Selection of materials and finishing systems		101							
	What guidance/ input is provided to the Designers? Identify		102							
	Have key details been identified and developed? ¹⁰³		104							

⁹⁵ The formal Best Practice Guide (BPG) was only published 990531. There was no discussion as yet about comparing the proposed details to the BPG details and validating deviations. The QAP suggests that this process should be undertaken in order to ensure all parties that their project cannot be criticized as not conforming to BPG principles.

⁹⁶ This become the location for sign - off.

⁹⁷ Polygon's "Quality is Free" manual is a de facto checklist of technical content requirements. Consultants have also been issued a "Consultant Working Drawing Checklist" which includes a combination of technical system requirements and graphic communication standards. Design review meetings are periodic and ongoing.

⁹⁸ I am unaware of any meaningful discussions to date re this.

⁹⁹ Many envelope failures are attributed to poor engineering system selections, detailing or installations. This area is often overlooked as building envelope "sign-off" may occur before engineering systes are fully selected/developed. Identify timing and process for review.

¹⁰⁰ The BEP issued a memo including "General Comments and Design Principles" which included nominal discussion of engineering systems.

¹⁰¹ The BEP "General Comments and Design Principles" memo commented on selections made by the Architect and/or Polygon.

¹⁰² The "General Comments and Design Principles" memo noted above.

¹⁰³ Refer to the Q-Tip under Tab 2, p.6 of the Quality Manual - "There are only 5 good house plans and 30 key details." Whether or not you agree with the Q-Tip, this is the stage of design where key envelope details should be identified and resolved.

¹⁰⁴ Most identified by the Architect. Further added to by the BEP and Polygon at the last design review meeting.

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	Design Development Output ¹⁰⁵									
	Design Development Review ¹⁰⁶									
	Design Development Verification ¹⁰⁷									
2.3.3	WORKING DRAWINGS & SPECIFICATIONS ¹⁰⁸									
	Working Drawing Output ¹⁰⁹									
	Working Drawing Review ¹¹⁰									
	Working Drawing Verification ¹¹¹									
	DESIGN VALIDATION									
	Have design concepts developed in earlier drawings and specs been maintained? ¹¹²									
2.3.4	Construction Documents									
	Has a master list of expected submittal and mock-ups been prepared? ¹¹³									
	Is there a list of preferred materials and systems? ¹¹⁴									
	Mockup ¹¹⁵ / Submittal design									
	Mockup / Submittal preparation									
	Mockup / Submittal Review									
	Mockup / Submittal Verification									

¹⁰⁵ This line tracks the expected due dates of design development output for review.

¹⁰⁶ This line tracks completion of design review activities.

¹⁰⁷ This line tracks design development sign-off

¹⁰⁸ As with many Designers, the Architects' design development drawings become their working drawings and specifications.

¹⁰⁹ This line tracks the expected due dates of working drawing output for review.

¹¹⁰ This line tracks completion of working drawing review activities.

¹¹¹ This line tracks working drawing sign-off

¹¹² Involves review of previous design reviews, revisiting the water management strategy, etc.

¹¹³ Although specifications and drawings often note these requirements, they are distributed throughout the documents, hence become difficult to identify and track. A master list is preferred. Identify procedures for this project.

¹¹⁴ Refer to the Quality Manual, item 2.3.4, Tab 2, p. 8, Q-Tip entitled "A Materials Hit List and a List of Material Hits" for further discussion.

¹¹⁵ Refer to the Quality Manual, Tab 2, p. 7, Q-Tip entitled "Some Tips on Mock Up's" for information about mockups.

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Ref.	Responsibility	Duc	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	How are Changes to the Work Handled? ¹¹⁶									
2.3.5	COMMISSIONING									
	Record Drawings									
	As-Built Drawings									

¹¹⁶ Identify specific procedures to avoid confusion. Refer also to the Quality Manual, Tab 2, Item 2.3.4 (d) and Q-Tip entitled "Four Kinds of Change."

**Quality Assurance Protocol
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QUALITY PLAN - Date revised: October 17, 2000

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Project Address: ditto

Customer Name: Polygon

Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8

Customer Tel/fax/e-mail: 877-1131/ 876-7610

Customer QM Rep.: Al Waring

QM Rep. tel/ fax/ e-mail as above

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

2.12	Document & Data Control	Due	Done	C ¹²⁰	D ¹²¹	GC	1 ¹²³	2 ¹²⁴	3 ¹²⁵	4 ¹²⁶
	Establish & maintain Document Log ¹²⁷									
	Establish/ Use of Controlled Doc. Stamp									
	Establish/maintain Documents Records									

¹¹⁷ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

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Customer QM Rep.: Al Waring
QM Rep. tel/ fax/ e-mail as above

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

3.1 ¹²⁸	Purchasing	Due	Done	C ¹³¹	D ¹³²	GC	1 ¹³⁴	2 ¹³⁵	3 ¹³⁶	4 ¹³⁷
	Document Purchasing activities ¹³⁸		139							
	Establish supplier assessment criteria									
	Assess suppliers & maintain assessment records									
	Ensure purchasing includes relevant envelope data ¹⁴⁰									
	Verify quality of received goods & services ¹⁴¹									
	Establish & maintain purchasing records									

¹²⁸ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

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¹³⁹ Polygon bases its subcontractor/supplier purchasing arrangements for major components on an amended version of the BCCA No. 200 Subcontract, "Standard Form of Construction Contract Between Prime Contractor and Sub-Contractor." The specific work scope is spelled out in an Appendix which is a template customized for each project.

¹⁴⁰ Use the Submittal Review form in the Forms section of this Manual to assist with this.

¹⁴¹ See also Section 4.10 - Receiving Inspection

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Ref.	Responsibility	Due	Done	Responsible Parties					
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3.2 ¹⁴²	Control of Customer-Supplied Product	Due	Done	C ¹⁴⁵	D ¹⁴⁶	GC	1 ¹⁴⁸	2 ¹⁴⁹	3 ¹⁵⁰	4 ¹⁵¹
	Establish/ communicate acceptance policy for customer-supplied product									
	Maintain records re customer-supplied product									

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Ref.	Responsibility	Due	Done	Responsible Parties					
				C	D	GC	1	2	3

3.3 ¹⁵²	Pdt. ID & Traceability	Due	Done	C ¹⁵⁵	D ¹⁵⁶	GC	1 ¹⁵⁸	2 ¹⁵⁹	3 ¹⁶⁰	4 ¹⁶¹
	Establish guidelines for identification & communicate to all QMR's									
	Maintain ID/Trace records									

¹⁵² This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

¹⁵³ Insert any known "Due" date in this column as a reminder

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Quality Assurance Protocol Test Drive by CMHC & Polygon Construction Ltd.		QUALITY PLAN - Date revised: October 17, 2000 Project Name: 5 th Ave. and Cypress St., Vancouver Project Address: ditto Customer Name: Polygon Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8 Customer Tel/fax/e-mail: 877-1131/ 876-7610 Customer QM Rep.: Al Waring QM Rep. tel/ fax/ e-mail as above							
Ref.	Responsibility	Due	Done	Responsible Parties					
				C	D	GC	1	2	3

4.1 ¹⁶²	BUILDING QUALITY - Process Control	Due	Done	C ¹⁶⁵	D ¹⁶⁶	GC ¹⁶⁷	1 ¹⁶⁸	2 ¹⁶⁹	3 ¹⁷⁰	4 ¹⁷¹
	Identify and disseminate the Project water management strategy ¹⁷²									
	Disseminate Work Instructions									
	Maintain a Construction Work Log Book									
	Maintain inspection records									
	Evaluate the project delivery model for impacts on process control									
	Coordinate subcontracts with related work scopes									
	Maintain & distribute a QMR ¹⁷³ directory									
	Maintain a construction schedule in a sequencing fashion appropriate to the building envelope									
	Label design drawings as to critical bldg. envelope elements									
	Select detail size for dissemination ease									
	Coordinate feedback re envelope drawings									
	Incorporate water management strategy on permitting documents									
	Communicate alternative/substitution requests to the BER ¹⁷⁴									

¹⁶² This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

¹⁶³ Insert any known "Due" date in this column as a reminder

¹⁶⁴ "Done" can be checked off or initialed when complete, as appropriate

¹⁶⁵ C = Customer: [QM Rep. Name/contact info]

¹⁶⁶ D = Designer: [QM Rep. Name/contact info]

¹⁶⁷ GC = General Contractor: [QM Rep. Name/contact info]

¹⁶⁸ 1 = [QM Rep. Name/contact info]

¹⁶⁹ 2 = [QM Rep. Name/contact info]

¹⁷⁰ 3 = [QM Rep. Name/contact info]

¹⁷¹ 4 = [QM Rep. Name/contact info]

¹⁷² It is expected each subscriber to the Protocol will amend these requirements to match their involvement.

¹⁷³ QMR = Quality Management Representative

¹⁷⁴ BER = Building Envelope Reviewer

Quality Assurance Protocol Test Drive by CMHC & Polygon Construction Ltd.		QUALITY PLAN - Date revised: October 17, 2000 Project Name: 5 th Ave. and Cypress St., Vancouver Project Address: ditto Customer Name: Polygon Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8 Customer Tel/fax/e-mail: 877-1131/ 876-7610 Customer QM Rep.: Al Waring QM Rep. tel/ fax/ e-mail as above								
Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	Review envelope reqts. at first site meeting									
	Design & construct envelope mock-up('s), evaluate and refine envelope as required									
	Maintain change list/log and chart progress									
	Clarify envelope cutting & patching specs.									
	Copy BER with change correspondence									
	Copy affected QMR's with change correspondence									
	Copy BER with permit amendments									
	Prepare and log required submittals									
4.9.5-8b/c	Instruct shop dwg. submitters re pre-engineering reqts. and seal reqts.									
	Prepare list of req'd BER field reviews ¹⁷⁵ & maintain log of status ¹⁷⁶									
	Distribute field review reports to affected QMR's ¹⁷⁷									
	Prepare list of warranty/maintenance requirements ¹⁷⁸									
	Collect maintenance information during Project progress ¹⁷⁹									
	Organize pre-occupancy review of envelope trades									

¹⁷⁵ This list should probably be prepared by the BER

¹⁷⁶ The BER may wish to maintain a log, but in any event there should be one posted prominently on site

¹⁷⁷ As some of the QMR's will be subcontracted to the Builder, and some will be consultants to the Owner, distribution should probably be by the BER to the consultants and the Site Superintendent to the Subcontractors, Suppliers and Installers.

¹⁷⁸ If this is not explicit in the specifications, it should probably be prepared by the BER

¹⁷⁹ This should be a Site Superintendent or Builder QMR activity

**Quality Assurance Protocol
Test Drive by CMHC &
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QUALITY PLAN - Date revised: October 17, 2000
Project Name: 5th Ave. and Cypress St., Vancouver
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Customer Address: 1800 Spyglass Place, Vancouver V5Z 4K8
Customer Tel/fax/e-mail: 877-1131/ 876-7610
Customer QM Rep.: Al Waring
QM Rep. tel/ fax/ e-mail as above

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

4.2 ¹⁸⁰	Inspection & Testing	Due	Done	C ¹⁸³	D ¹⁸⁴	GC ¹⁸⁵	1 ¹⁸⁶	2 ¹⁸⁷	3 ¹⁸⁸	4 ¹⁸⁹
	Receiving Inspection ¹⁹⁰									
	Be responsible for receiving inspection									
	Identify "critical" product									
	Determine level of inspection effort									
	Obtain Conformance Cert. ¹⁹¹									
	Maintain Receiving Inspection Log									
	Communicate quality requirements to Suppliers									
	Perform receiving inspections									
	Advise Suppliers as to results of Receiving inspections									
	In Process Inspection									
	Be responsible for in-process inspections ¹⁹²									
	Perform Patrol Inspections									
	Perform in-process inspections and report results to affected parties									
	Maintain records of in-process inspections									
	Review defective elements when corrected									
	Final Inspection and Testing									
	Be responsible for final inspection/ testing									
	Define scope of final inspection/ testing									

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¹⁸⁹ 4 = [QM Rep. Name/contact info] _____

¹⁹⁰ Each Building Envelope Provider should develop this column of entries consistent with its detailed practices.

¹⁹¹ List items requiring Certificate of Conformance

¹⁹² In most circumstances there will be several reviewers providing in-process inspection services. The activities requiring in-process inspection should be listed, plus the responsible party.

**Quality Assurance Protocol
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 Customer Tel/fax/e-mail: 877-1131/ 876-7610
 Customer QM Rep.: Al Waring
 QM Rep. tel/ fax/ e-mail as above

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

	Perform final inspection and testing									
	Verify satisfactory completion or identify nonconforming installations									
	Review defective work when corrected									
	Maintain records of final inspection and testing									

**Quality Assurance Protocol
Test Drive by CMHC &
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Customer QM Rep.: Al Waring
QM Rep. tel/ fax/ e-mail as above

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

4.6193	Inspection, measuring & test equipment	Due	Done	C ¹⁹⁶	D ¹⁹⁷	GC ¹⁹⁸	1 ¹⁹⁹	2 ²⁰⁰	3 ²⁰¹	4 ²⁰²
	Establish party responsible for activities ²⁰³									
	Identify eqpt. needing calibration									
	Establish calibration frequency									
	Log calibration activities									
	Keep calibration logs									

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Ref.	Responsibility	Due	Done	Responsible Parties							
				C	D	GC	1	2	3	4	

4.7 ²⁰⁴	Inspection & test status	Due	Done	C ²⁰⁷	D ²⁰⁸	GC ²⁰⁹	1 ²¹⁰	2 ²¹¹	3 ²¹²	4 ²¹³
	Maintain inspection status of purchased materials ²¹⁴									
	Maintain inspection status of pre-fab'd and assembly pdts.									
	Maintain inspection status of final insp., commissioning									
	Maintain inspection and test records									

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

4.8215	Control of Nonconforming product	Due	Done	C ²¹⁸	D ²¹⁹	GC ²²⁰	1 ²²¹	2 ²²²	3 ²²³	4 ²²⁴
	Confirm responsibility for nonconforming product ²²⁵									
	Maintain non-conforming procedures									
	Maintain non-conforming records									

²¹⁵ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

²¹⁶ Insert any known "Due" date in this column as a reminder

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Ref.	Responsibility	Due	Done	Responsible Parties					
				C	D	GC	1	2	3

4.9 ²²⁶	Corrective & preventative action ²²⁷	Due	Done	C ²³⁰	D ²³¹	GC ²³²	1 ²³³	2 ²³⁴	3 ²³⁵	4 ²³⁶
	Develop CAR form/ procedure ²³⁷									
	Report problems on CAR forms		238							
	Log CAR									
	Investigate problem in CAR									
	Implement solutions to identified problems									
	Change existing practices and procedures to reduce future problems									
	Confirm completion of remedial work									
	Keep records of CAR's and LOGs									

²²⁶ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

²²⁷ Polygon has many projects at various stages at any given time. Its Quality Assurance Dept. tracks completion deficiencies by project and date, and summarizes same for weekly operations meetings. This integrated approach helps in the identification of any deficiency patterns, as well as providing an easy means of identifying performance targets.

²²⁸ Insert any known "Due" date in this column as a reminder

²²⁹ "Done" can be checked off or initialed when complete, as appropriate

²³⁰ C = Customer: [QM Rep. Name/contact info]

²³¹ D = Designer: [QM Rep. Name/contact info]

²³² GC = General Contractor: [QM Rep. Name/contact info]

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²³⁷ Each Building Envelope Provider should develop this column of entries consistent with its detailed practices.

²³⁸ Polygon's general approach is noted above. It identifies unit by unit deficiency lists as "Addendum to Possession Certificate [Project Name]", ensuring purchasers identify deficiencies and their correction presumably becomes a condition of title transfer. The list itself is a matrix of rooms and surfaces, allowing easy identification of specific problems.

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Ref.	Responsibility	Duc	Done	Responsible Parties						
				C	D	GC	1	2	3	4

4.10	Handling, Storage, packaging, preservation & delivery	Duc	Done	C ²⁴²	D ²⁴³	GC ²⁴⁴	1 ²⁴⁵	2 ²⁴⁶	3 ²⁴⁷	4 ²⁴⁸
	Establish responsibility for Handling activities ²⁴⁹									
	Determine Product handling requirements									
	Verify appropriate Handling									
	Determine Product storage requirements									
	Verify appropriate storage									
	Determine Product packaging requirements									
	Verify appropriate packaging									
	Determine Product preservation requirements									
	Verify appropriate preservation									
	Determine Product delivery requirements									
	Verify appropriate delivery									
	Maintain Handling records.									

²³⁹ This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

²⁴⁰ Insert any known "Due" date in this column as a reminder

²⁴¹ "Done" can be checked off or initialed when complete, as appropriate

²⁴² C = Customer: [QM Rep. Name/contact info]

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

5.1250	Control of Quality records	Due	Done	C ²⁵³	D ²⁵⁴	GC ²⁵⁵	1 ²⁵⁶	2 ²⁵⁷	3 ²⁵⁸	4 ²⁵⁹
	Define responsibility for quality record establishment and maintenance ²⁶⁰									
	Develop the template of quality records in accordance with defined principles									
	Define retention and disposal policies									
	Determine need for a disposal record and implement as appropriate									
	Establish and maintain appropriate storage facilities									
	Maintain quality records defined in the Quality Manual									

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

5.2 ²⁶¹	Internal quality audits	Due	Done	C ²⁶⁴	D ²⁶⁵	GC ²⁶⁶	1 ²⁶⁷	2 ²⁶⁸	3 ²⁶⁹	4 ²⁷⁰
	Establish responsibility for conducting internal audits & taking corrective measures ²⁷¹									
	Perform internal quality audits									
	Maintain audit records									

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QM Rep. tel/ fax/ e-mail as above

Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

5.3272	Training	Due	Done	C ²⁷⁵	D ²⁷⁶	GC ²⁷⁷	1 ²⁷⁸	2 ²⁷⁹	3 ²⁸⁰	4 ²⁸¹
	Identify training needs ²⁸²									
	Assess training levels of staff & develop list of substitutes to cover unforeseen reqts.									
	Maintain training records									
	Maintain Personnel Skills Inventory									

²⁷² This is where to place the Quality Manual/ ISO Reference, so that a user can refer to the full text for explanations of responsibilities.

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Ref.	Responsibility	Duc	Done	Responsible Parties						
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5.4 ²⁸³	Servicing	Duc	Done	C ²⁸⁶	D ²⁸⁷	GC ²⁸⁸	1 ²⁸⁹	2 ²⁹⁰	3 ²⁹¹	4 ²⁹²
	Delegate responsibility for servicing ²⁹³									
	Be responsible for servicing									
	Establish guidelines for provision of servicing activities									
	Establish and maintain list of approved servicing providers									
	Periodically review service activities, records and servicing provider lists and performance ²⁹⁴									
	Monitor customer satisfaction with servicing									
	Amend servicing policies where customers are dissatisfied									

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²⁹⁴ Choose a suitable periodic time frame for review - a minimum of annually is recommended.

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Ref.	Responsibility	Due	Done	Responsible Parties						
				C	D	GC	1	2	3	4

5.5295	Statistical Techniques	Due	Done	C ²⁹⁸	D ²⁹⁹	GC ³⁰⁰	1 ³⁰¹	2 ³⁰²	3 ³⁰³	4 ³⁰⁴
	Define the selection and use of selected statistical techniques suitable for verifying conformance of the building envelope quality to specified requirements. ³⁰⁵									
	Identify need for use of statistical techniques, their selection and implementation									
	collect and, where appropriate, analyze gathered statistical data									
	communicate results of statistical analysis									
	Ensure that all personnel utilizing statistical techniques (i.e. checksheets) are trained in their use									
	Ensure that whenever required, assistance is provided to the Quality Assurance Department in gathering statistical data									
	Ensure that adequate resources are allocated for training of the personnel in selected statistical techniques.									

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³⁰⁴ **4 =** [QM Rep. Name/contact info] _____

³⁰⁵ Each Building Envelope Provider should develop this column of entries consistent with its detailed practices.

[Company Logo] [Company address] [Company tel/fax/e-mail]	Purchase Order #	
	Project No.	
	Cost Code No.	
	Date Issued:	
Purchase Order to (Supplier/Installer):	Date Required at Project:	
	Ship to: Project Other:	
	Project Name:	
	Project Address:	
Contact Name:	Contact Name:	
Contact Tel./fax:	Contact Tel./fax:	

For the above-noted project, to provide labour, material, equipment and supervision necessary for:
Supply only Supply and installation of (Describe work):

[Insert work/material/product description here]

Work of this Contract includes, but is not necessarily limited to, the attached Scope of Work (Supplier/Installer to initial)

TOTAL CONTRACT VALUE		\$
Provincial Sales Tax (P.S.T.) is included. Goods and Services Tax (G.S.T.) is <u>not</u> included.		
In accordance with drawings (List):	Dwg. title(s)	Issue date:
In accordance with specifications prepared by (List Designer and spec title(s)):	Specifications title(s):	Issue date:
In accordance with the Submittal Review dated:	Submittal Review date:	(Copy of Submittal Review attached and initialed by the Supplier/Installer)
In accordance with your Quotation dated:	Quotation date:	(Copy of Quotation attached and signed/initialed by the Supplier/Installer)
We hereby agree to perform the work and supply the materials, labour, service and equipment necessary therefore on the terms and conditions set out herein and on the back of this Purchase Order:	Accepted by: [Insert Project Company Name]	
per _____	per _____ (Authorized Signatory)	
Title _____	Title _____ Tel/fax/e-mail _____	
The Quality Management Representative for us on this Project is:	The Quality Management Representative for us on this Project is:	
_____	_____	
(Print Name)	(Print Name)	
_____	_____	
(Tel/fax/e-mail)	(Tel/fax/e-mail)	

[Company Logo] [Company address] [Company tel/fax/e-mail] QMR Rep: Tel/ fax/ e-mail:	BUILDING ENVELOPE DESIGN REVIEW MEETING Date: Project Name: Project Address: Customer Name: Customer Address: Customer Tel/fax/e-mail: Customer QMR Rep.: QMR Rep. tel/ fax/ e-mail
--	--

ATTENDEES: (List)

1. GENERAL:¹

1.1. ACTION ALL

NOTE the following building envelope scope of work undertaken by The Building Envelope Reviewer:²

1. DOCUMENT REVIEW/ SITE VISIT

We will review the design drawings and specifications provided (one occasion) and advise in writing of any area(s) where we believe them to be deficient as regards the intent of Bulletin 96-02, Bulletin 96-25 and VBBL Part 5³, and also in relation to other current building envelope design principles and practices.

2. TEAM MEETING

After submitting our report, we will meet on [] occasion(s) with the Quality Management Representatives of the Designers/ Builders/ Suppliers and/or Installers⁴ and others invited by them to review our report, suggested design details⁵, procedures, materials, systems, our recommendations and expectations for the project's building envelope. We will minute these meetings and use these minutes as the basis for our subsequent services and reviews.

3. ACCEPTANCE OF DOCUMENTS

We will consult with the Designers/ Builders/ Suppliers and/or Installers and/or their Quality Management Representatives by phone and fax and review additional or revised details and specifications provided as a consequence of our document review & team meeting, and confirm their acceptance in writing. We will copy our correspondence to the appropriate Quality Management Representatives.

4. CONSTRUCTION SITE MEETING

After the acceptance of documents, we will attend a site meeting including the Quality Management Representatives of the Designers/ Builders/ Suppliers and/or Installers and others invited by them to review recommended site practices, minimum inspection requirements, submittal requirements, etc. We will minute these meetings and use these minutes as the basis for our subsequent services and reviews.

5. CONSTRUCTION MOCK-UP'S:

Since the project documents may not address the sequence of construction (as noted in Bulletins 96-02 and 96-25), we will liaise with the Builder as regards appropriate construction sequences and methods which need to be verified through prototype or mock-up. A sample of the elements in question will be constructed for our review and acceptance. This sample will be used as the standard for the balance of the project.

6. FIELD REVIEW & CERTIFICATION:

[Company Logo] [Company address] [Company tel/fax/e-mail]	BUILDING ENVELOPE DESIGN REVIEW MEETING Date: Project Name: Project Address:
QMR Rep: Tel/ fax/ e-mail:	

We will perform the ongoing field reviews required by VBBL Part 5 and P&L Bulletins 96-02 and 96-25, and when the work is satisfactorily completed, we will provide letters of assurance covering the envelope elements we have reviewed. The field reviews will be carried out at intervals appropriate to the stage of construction which we consider necessary to determine if the work is in general conformity with the approved construction documents. However we are not required to make exhaustive or continuous on-site reviews. We will report to the Contractor, Developer/Owner and the Quality Management Representatives of the Designers/ Builders/ Suppliers and/or Installers as appropriate as to deficiencies in the work observed during the course of field reviews. Reviews conducted by us are for the following purposes: 1) to examine, evaluate and report to you upon representative samples of the work; any comments on the balance of the work made during the course of the field reviews are assumptions based on extrapolation; 2) to determine if the work is in general conformity with Part 5 of the [Vancouver Building Bylaw and City of Vancouver Bulletins 96-02 and 96-25] [B.C. Building Code], copies of which are to be kept on the construction site. Deficiencies identified in field reviews are to be promptly corrected in accordance with our recommendations. Our final certification will only be provided when we are satisfied that remedial work has been satisfactorily completed.

All project participants are asked to keep the Building Envelope Reviewer role in mind as they perform their services. Feel free to consult us as regards problems/issues arising in the course of construction.

2. BUILDING ENVELOPE STRATEGY:

The following was agreed as a suitable strategy for managing water for this project:

2.1 Thermal Resistance of Assemblies -

It is the responsibility of the Designers to obtain approvals from the city's Energy Utilization Department. The Building Envelope Reviewer will rely upon the soils report for the determination of subsurface information.

Products and assemblies which require particular attention as regards their thermal resistance include the following: [hereafter some samples]:

Metal framed glazed assemblies separating interior conditioned spaces from exterior or unconditioned spaces and requiring a thermal break include: (Those double asterisked (**)) are required to have a fire resistance rating, hence do not require a thermal break)

-

Conductive components penetrating the building envelope, and the proposed/ recommended method(s) to minimize condensation, include:

-

2.2 Air Barrier Systems

The air barrier system(s) proposed/recommended for the project, and measures to ensure continuity, include:

-

To ascertain that wood structural members and structural sheathing do not exceed 19% moisture content prior to installing the air barrier system, we propose the following:

[Company Logo] [Company address] [Company tel/fax/e-mail]	BUILDING ENVELOPE DESIGN REVIEW MEETING Date: Project Name: Project Address:
QMR Rep: Tel/ fax/ e-mail:	

•

2.3 Vapour Barriers

The vapour barrier system(s) proposed/recommended for the project, and measures to ensure continuity, include:

•

To ascertain that wood structural members do not exceed 19% moisture content prior to installing the air barrier system, we propose the following:

•

2.4 Protection from Precipitation -

Rain water can be expected to impact the project building[s] as follows: [Describe the path of rainwater from areas of impact to drainage, noting where design details such as overhangs will reduce impact, and in particular areas where there are discontinuities in the handling of water.]

The following measures are proposed/recommended to minimize the ingress of precipitation into assemblies and components:

•

The following measures are proposed/recommended to prevent the ingress of precipitation into interior spaces:

•

The following measures are proposed/recommended to drain moisture to the exterior:

•

2.5 Sealing, Drainage, Accumulation and Disposal -

The following measures are proposed/recommended to shed precipitation and drain moisture to the exterior:

•

2.6 Protection from Surface Water -

Ground water from off site [will be generally directed away from the subject site by [list devices]] [may be expected to enter the site [list locations] and will flow through the site by [list devices]]

2.7 Foundation and Floor Drainage [Verify that the design includes suitable foundation drainage.]

2.8 Protection from Moisture in the Ground

3. TENDERING:

[Company Logo] [Company address] [Company tel/fax/e-mail] QMR Rep: Tel/ fax/ e-mail:	BUILDING ENVELOPE DESIGN REVIEW MEETING Date: Project Name: Project Address:
--	---

3.1. ACTION ARCHITECT/CONTRACTOR - Copy the Building Envelope Reviewer with documentation re proposed alternative products or substitutions relating to the building envelope, to allow the Building Envelope Reviewer to review compliance with the water management strategy.

4. CHANGES:

4.1. ACTION ARCHITECT/CONTRACTOR - Copy Building Envelope Reviewer with documentation re proposed Changes to the Work, RFI's, Site Instructions, etc., relating to the building envelope, to allow Building Envelope Reviewer to review compliance with the water management strategy. Use the "Submittal Review" form for this purpose.

9. SUBMITTALS AND FIELD REVIEWS:

9.1. ACTION CONTRACTOR - Building Envelope Reviewer to receive manufacturers' literature describing proposed materials and systems of trades noted below. Allow Building Envelope Reviewer 48 hours for review and comment back, as regards timing for ordering of materials. Building Envelope Reviewer to receive construction schedule and be advised minimum 48 hours in advance of commencement of work of following trades:

- Membrane waterproofing
- Deck/ balcony waterproofing
- Roofing
- Peel & Stick membranes
- Building paper/ air barriers
- Cladding
- Windows, doors and skylites - shop drawings required, including associated flashing
- Mechanical penetrations (vents, ducts, flues, etc.) through horizontal and vertical envelope - shop drawings or manufacturer's literature required, including associated flashing
- Exterior handrails and guardrails - shop drawings required

A sample Building Envelope Field Review Report is attached for reference and as an indication of the scope of field reviews required for the project.

10. OCCUPANCY/COMPLETION:

10.1. Currently scheduled occupancy date: _____

10.2 It is understood that the Building Envelope Reviewer will not be able to provide an assurance letter regarding the building envelope until remedial work requested during field review has been completed.

NOTES:

1. These minutes are prepared as part of the Building envelope services for this project, as required by the municipality. Copies may be distributed to the municipality. Contractor, please distribute to appropriate subcontractors and suppliers. Report any discrepancies to the writer within 5 working days of the meeting date or all items will be assumed to be correct. E&OE.
2. Attention to the item(s) with the notation "SEE NOTE 2 BELOW" will involve additional services by the Building Envelope Reviewer, which will be charged in accordance with our contract agreement.

¹ NOTE: The content of this meeting template has not been reviewed in detail by legal counsel.

² This is a typical scope of services which will vary depending upon the Reviewer's services contract. Note that, at the moment, there is no mandatory scope of services.

[Company Logo] [Company address] [Company tel/fax/e-mail] QMR Rep: Tel/ fax/ e-mail:	BUILDING ENVELOPE DESIGN REVIEW MEETING Date: Project Name: Project Address:
--	--

-
- ³ Wording for projects in Vancouver
- ⁴ Again, the attendees are a function of the Reviewer's services scope and the state of the Project.
- ⁵ here, reference should be made to the Best Practices Guide

Document Name:					
COPY #	CONTROLLED COPY	DATE ISSUED	ISSUED TO: COMPANY DEPARTMENT	ADDRESSEE NAME	COMMENTS
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			
	YES <input type="radio"/> NO <input type="radio"/>	____/____/____ ---			

PAGE _____

PAGE _____

CONTROLLED DOCUMENT NUMBER _____	
Copy Number	
Controlled Copy	YES <input type="checkbox"/> NO <input type="checkbox"/>

This is the master layout for suggested forms forming part of the Quality Manual. In this sample, the header has been replaced by this comment so that the header itself can be footnoted as to instructions for use.

<p>[Company Logo]¹ [Company address] [Company tel/fax/e-mail]</p> <p>QMR Rep: Tel/ fax/ e-mail:</p>	<p>[Form Name]²</p> <p>Project Name:³ Project Address: Customer Name: Customer Address: Customer Tel/fax/e-mail: Customer QMR Rep.: QMR Rep. tel/ fax/ e-mail</p>
--	---

The balance of the form content appears in this space. Endnotes are attached as instructions for filling out.

¹ This portion of the header could contain appropriate graphic recognition. As a minimum, all of the information noted here should be included.

² This header and all this contact information appears on each page of the form.

³ This form is designed for fill in by computer. Blank lines could be used for manual fill in.

CMHC SCHL
Helping to house
Canadians.

"HOLD" TAG LOG

[illegible]

Status Codes: H - Hold B - Reject / Return U - Use R - Rework I - Inspect
S - Scrap

PAGE: _____

Status Codes: A - Problem described / reported B - Investigation completed - corrective / preventive action determined C - Corrective / preventive action introduced D - Effectiveness of the corrective / preventive action verified

File No.:	CARLOG3	Issue:	A	Date:	10/17/2000	Page :	1	of	1
-----------	---------	--------	---	-------	------------	--------	---	----	---

CAR #	DATE ISSUED	BRIEF DESCRIPTION OF THE PROBLEM	ORIG. DEP'T	CRITICAL PROBLEM		CAR STATUS				DATE COMPLETED
				YES	NO	A	B	C	D	
---	dd / mm / yy	---	---							dd / mm / yy
										___ / ___ / ___
	___ / ___ / ___									___ / ___ / ___
	___ / ___ / ___									___ / ___ / ___

Status Codes: A - Problem described / reported B - Investigation completed - corrective / preventive action determined
 C - Corrective / preventive action introduced D - Effectiveness of the corrective / preventive action verified

PAGE: _____

Status Codes:	A - Problem described / reported	B - Investigation completed - corrective / preventive action determined
	C - Corrective / preventive action introduced action verified	D - Effectiveness of the corrective / preventive

File No.:	CARLOG3	Issue:	A	Date:	10/17/2000	Page :	1	of	1
-----------	---------	--------	---	-------	------------	--------	---	----	---

[Company Logo]

Submittal Review

©2000 [company]. E&OE. This review is for the sole purpose of reviewing conformance to principles of building science and to applicable building codes, by-laws & construction documents. It does not guarantee that the proposed design & subsequent construction contain no aspects which might contravene building science principles, and does not mean we approve or warrant the detailed design of others or the design inherent in shop drawings, manufacturer's literature or material & system samples. It does not relieve the Designers, Builders, Suppliers and Installers of their responsibility for errors or omissions in drawings, specifications, shop drawings or manufacturer's literature or of their responsibility for meeting all requirements of the Contract Documents and applicable building codes & regulations. The Contractor is responsible to confirm and correlate dimensions, for information pertaining solely to fabrication processes or for techniques of construction & installation and for the work of all subtrades.

Project Name	
Project Address	
Our file #	[file#]-8
Owner	[name] tel /fax /e-mail
Builder	[name] tel /fax /e-mail
Builder Site Rep.	[name] tel /fax /e-mail
Designer	[name] tel /fax /e-mail
Reviewer	[name] tel /fax /e-mail
File name	8 submittal log/list.rtf - copied to those noted above u.o.n.

Submittal Review - [Product]
SUMMARY COMMENTS: Elements of this submittal which are not part of [the exterior building envelope] [or] [building code requirements] have not been reviewed by [company]
Date information received for review: 2000-10-17
PURPOSE OF THIS SUBMITTAL:
<input type="checkbox"/> FOR REVIEW PRIOR TO FABRICATION AND/OR INCORPORATION INTO THE PROJECT
<input type="checkbox"/> ANALYSIS OF PROPOSED ALTERNATIVE/ SUBSTITUTION
CONTENT OF THIS SUBMITTAL (Check all appropriate boxes):
<input type="checkbox"/> SHOP DRAWINGS
<input type="checkbox"/> MANUFACTURER'S LITERATURE
<input type="checkbox"/> SAMPLES
<input type="checkbox"/> OTHER:

Minimum List of Submittals required by Building Envelope Professional (BEP)

Spec section/ item	Mock up req'd	Type of submittal (shaded not req'd)			
		Manu. literature ¹	Shop drawing	Test data	Sample ²
01300 Construction schedule					
02074 geotextile					
03300 concrete mix design					
03400 precast concrete					
03600 grout					
04050 brick ties					
04050 weepholes					
04200 masonry units					

¹ Manufacturers literature indicating proposed product(s), performance standards, application directions and method(s) of fastening to/through substrate(s)

² sample means each unit type, together with name of unit, supplier, available tech. data.

[Company Logo]

Submittal Review

©2000 [company]. E&OE. This review is for the sole purpose of reviewing conformance to principles of building science and to applicable building codes, by-laws & construction documents. It does not guarantee that the proposed design & subsequent construction contain no aspects which might contravene building science principles, and does not mean we approve or warrant the detailed design of others or the design inherent in shop drawings, manufacturer's literature or material & system samples. It does not relieve the Designers, Builders, Suppliers and Installers of their responsibility for errors or omissions in drawings, specifications, shop drawings or manufacturer's literature or of their responsibility for meeting all requirements of the Contract Documents and applicable building codes & regulations. The Contractor is responsible to confirm and correlate dimensions, for information pertaining solely to fabrication processes or for techniques of construction & installation and for the work of all subtrades.

Project Name	
Project Address	
Our file #	[file#]-8
Owner	[name] tel /fax /e-mail
Builder	[name] tel /fax /e-mail
Builder Site Rep.	[name] tel /fax /e-mail
Designer	[name] tel /fax /e-mail
Reviewer	[name] tel /fax /e-mail
File name	8 submittal log/list.rtf - copied to those noted above u.o.n.

04210 clay masonry units					
04400 stone masonry					
05050 steel primer					
05100 structural steel					
05200 metal joists					
05300 metal deck					
05400 cold formed metal framing					
05500 metal fabrications					
05520 handrails/ guardrails			3		
07050 RCABC warranties					
07100 Dampproofing					
07180 traffic coating					
07190 water repellant					
07200 building insulation					
07200 spray foam insulation					
07240 EIFS			4		
07270 ADA gaskets					
07270 ADA sealant					
07270 sill gasket					
07300 shingle					
07300 roof tile					
07311 asphalt shingles					
07318 wood shingles					
07400 siding panels					
07500 w'proofing membrane					
07550 SBS roofing					
07600 flashing/ sheet metal					
07655 peel & stick					
07655 peel & stick primer					

³ Guardrail/handrail shop drawings indicating fastening details to bldg. envelope. Gasketed fasteners expected, no caulking daubs or similar. Specify fastener materials (re compatibility)

⁴ Shop Drawings indicating actual application details customized for the project.

[Company Logo]

Submittal Review

©2000 [company]. E&OE. This review is for the sole purpose of reviewing conformance to principles of building science and to applicable building codes, by-laws & construction documents. It does not guarantee that the proposed design & subsequent construction contain no aspects which might contravene building science principles, and does not mean we approve or warrant the detailed design of others or the design inherent in shop drawings, manufacturer's literature or material & system samples. It does not relieve the Designers, Builders, Suppliers and Installers of their responsibility for errors or omissions in drawings, specifications, shop drawings or manufacturer's literature or of their responsibility for meeting all requirements of the Contract Documents and applicable building codes & regulations. The Contractor is responsible to confirm and correlate dimensions, for information pertaining solely to fabrication processes or for techniques of construction & installation and for the work of all subtrades.

Project Name	
Project Address	
Our file #	[file#]-8
Owner	[name] tel /fax /e-mail
Builder	[name] tel /fax /e-mail
Builder Site Rep.	[name] tel /fax /e-mail
Designer	[name] tel /fax /e-mail
Reviewer	[name] tel /fax /e-mail
File name	8 submittal log/list.rtf - copied to those noted above u.o.n.

07714 gutters/ rwl's					
07900 sealants					
08050 window test data ⁵					
08100 metal doors & frames					
08200 wood/plastic doors					
08300 specialty doors					
08400 storefront			6		
08520 aluminum windows					
08550 wood windows					
08560 vinyl windows					
08600 skylites					
08700 hardware					
08800 glazing					
08900 curtain wall					
09900 vapour barrier primer					
09980 masonry/concrete coatings					

⁵ Expected Performance ratings (Vancouver/Victoria areas) are: to 4 storey: A2 air leakage; B3 water penetration; C3 wind resistance (C rating proof waived if shop drawings P.Eng. sealed); above 4 storeys: to be advised by Building Envelope Professional, based on A440 Guidelines.

⁶ Frame and fastening details. Sill flashing details. end dams expected. Weepholes or other water drainage strategy expected. Water management strategy explicit on drawings. Recommended sealants for interfaces - by brand name.

[Company Logo]
[Company address]
[Company tel/fax/e-mail]

QMR Rep:
Tel/ fax/ e-mail:

SUBMITTAL REVIEW

Project Name:
Project Address:
Customer Name:
Customer Address:
Customer Tel/fax/e-mail:
Customer QMR Rep.:
QMR Rep. tel/ fax/ e-mail

This form must be completely filled in with all relevant data and submitted to the Building Envelope Reviewer for consideration. Where an alternative or substitution is requested: a) the proposal may be rejected if it is incomplete or unclear; b) any additional costs to the Project are to be borne by the applicant, including redesign costs; c) any anticipated reduction in costs to the Project shall entitle the Owner to an appropriate credit.

SUBMISSION/SCHEDULING DATA:

DATE SUBMITTED: _____ DATE RECEIVED BY REVIEWER: _____

DATE by which response is required to maintain contract schedule: _____

SUBMITTAL MADE BY: Same as header above left OTHER (Specify name & Contact Information): _____

PURPOSE OF THIS SUBMITTAL:

SUPPORTING TENDER SUPPORTING REQUEST FOR ALTERNATIVE OR SUBSTITUTION
FOR REVIEW PRIOR TO FABRICATION AND/OR INCORPORATION INTO THE PROJECT
OTHER (Specify: _____)

CONTENT OF THIS SUBMITTAL (Check all appropriate boxes):

PROPOSED PRODUCTS LIST SHOP DRAWINGS PRODUCT DATA SAMPLES WARRANTY

For a proposed alternative/substitution, attach the following information as a minimum:

1. Manufacturer's technical data sheets re proposed products
2. Manufacturer's standard form of warranty proposed for this project
3. Letter on manufacturer's letterhead stating that the manufacturer will warrant the products as proposed.
4. Letter(s) from Suppliers and Installers responsible for the works affected by the proposed alternative/substitution which state the total cost(s) of any alteration work they will require to do to accommodate the proposed alternative/substitution.

FILL IN THE REMAINING PORTIONS FOR A PROPOSED ALTERNATIVE OR SUBSTITUTION: ALTERNATIVE/SUBSTITUTION REQUESTED IS FOR:

Named product Product type, material, finish or formulation Fabrication or installation methods

Other (Specify): _____

REASON FOR REQUEST: _____

The product/ material/ method for which an alternative/substitution is requested is shown on the following documents:

Specification Section #: _____ Page(s) _____ Clause No(s): _____

Drawings: (List Drawings Nos. and Detail Nos. affected): _____

Describe in detail any alteration to any other part of the Project required by use of the requested alternative/substitution: _____

[Company Logo] [Company address] [Company tel/fax/e-mail] QMR Rep: Tel/ fax/ e-mail:	<h2 style="margin: 0;">SUBMITTAL REVIEW</h2> Project Name: Project Address:
--	---

Total net cost or credit for any such other required alteration, including overhead & profit:	\$
Cost of builder's administration (to be filled in by Builder):	\$
Cost of Designer's documentation & administration (to be filled in by affected Designers):	\$
Total cost of such alterations (to be filled in by Designer):	\$
Total cost savings achieved (from following data, to be filled in by Designer):	\$
Total cost/benefit to Owner (to be filled in by Designer):	\$

Benefits to Owner other than financial:

Fill in the following as applicable to the product, material or method proposed for alternative/ substitution. If the item is mentioned in the Specification as a performance or material requirement, then information about the proposed alternative/substitution is required by the Designer to evaluate the proposal. Requests lacking sufficient information will be returned without action.

Specified product, material or method:	Proposed alternative/ substitution:
Description:	Description:
Product name:	Product name:
Type:	Type:
Model No.:	Model No.:
Thickness(es):	Thickness(es):
Composition:	Composition:
Adjacent specified materials (List):	Compatibility with adjacent specified materials Yes No If NO, specify proposed solution:
Resistance to chemical(s) (list):	Resistance to chemical(s) (list):
Thermal resistance (specify units):	Thermal resistance (specify units):
Vapour resistance ((Pa x sq.m.)/ng): LOWrh: HIGHrh:	Vapour resistance ((Pa x sq.m.)/ng): LOWrh: HIGHrh:
Density (kg/cu.m):	Density (kg/cu.m):
Moisture content (kg/sq.m.): @100%rh: saturated:	Moisture content (kg/sq.m.): @100%rh: saturated:
Substrate preparation req'd:	Substrate preparation req'd:
Availability (time):	Availability (time):
Country of manufacture:	Country of manufacture:
Applicable Cdn codes/stds. (Specify stds. met)	Meets applicable Cdn codes/stds. Yes No (Specify stds. met)
Length of warranty: available: proposed:	Length of warranty: available: proposed:

[Company Logo] [Company address] [Company tel/fax/e-mail] QMR Rep: Tel/ fax/ e-mail:	SUBMITTAL REVIEW Project Name: Project Address:
--	--

Other specifid performance criteria:	Other specifid performance criteria:
Unit cost of product/material (must be completed):	Unit cost of product/material (must be completed):
\$_____ per Unit _____	\$_____ per Unit _____
Units req'd _____ Total value \$ _____	Units req'd _____ Total value \$ _____
I certify that I have checked the above documentation for the proposed alternative/substitution and warrant it to be substantially complete and accurate: (Signature of proponent): _____ Date: _____	

STATUS OF SUBMITTAL REVIEW: REVIEWED REVIEWED AS NOTED REVISE & RESUBMIT REJECTED REVIEWER: _____ Date: _____ COMMENTS: _____

LIMITATIONS OF SUBMITTAL REVIEW: This review is for the sole purpose of ascertaining conformance to sound principles of building envelope science as well as to the applicable building bylaws, codes and applicable municipal policies and to the design intent. This review does not guarantee that the proposed design and subsequent construction contain no aspects which might contravene sound building envelope science principles. This review shall not mean that Building Envelope Reviewer approves or warrants the detail design of others or the design inherent in shop drawings, manufacturer's literature or material and system samples, responsibility for which shall remain with the Designers, Builders, Suppliers and/or Installers submitting same. This review shall not relieve the Designers, Builders, Suppliers and/or Installers of their responsibility for errors or omissions in drawings, specifications, shop drawings or manufacturer's literature or of their responsibility for meeting all requirements of the Contract Documents and applicable building codes and regulations. The Contractor is responsible to confirm and correlate dimensions, for information that pertains solely to fabrication processes or for techniques of construction and installation and for the work of all subtrades. E&OE

[Logo]

Field Review Report

©2000 [Company]. E&OE. Not to be reproduced without prior written consent. Unless notified within 24 hours, report contents accepted as correct. These comments regard the progress of the work and compliance with applicable codes, by-laws and construction documents. The Builder shall promptly notify the signator of this report for re-inspection when ready. The Builder remains responsible for the correction of deficient work, whether stated herein or not.

Project Name
Project Address
Our file #
Owner
Builder
Builder Site Rep.
Designer
[Other]
File name 9 field review pad/list.rtf - NOTE: Distribution is to those noted above u.o.n. below

Author				Also present:	
Date:				Field Review Conditions • sunny cloudy drizzle rain snow approx. deg C	
Report # <input type="text" value="1"/>		Weather:			
		Temperature:			
Action 234	By ⁵	Location 6	# ⁷	Field Review Notes & Observations⁸	
Purpose of field review: ⁹					
				Work in Progress - Observations ¹⁰ •	
Action by:		Due		Information or Action Required:¹¹	
				Additional Comments:¹²	

¹ It is a good idea to sequentially number field reviews in order that recipients know if they miss one, also for cross referencing specific observations.

² **F** (Contractor fill in date when ready) - work requiring a Follow up Field Review is indicated with an unticked box and the "F-" prefix as shown here

³ **P** deficient work which may be covered up after correction, but of which the Contractor must take a picture illustrating the repair/completion, for presentation to us at the next meeting, is indicated with an unticked box and the "P-" prefix as shown here

⁴ **C** (Contractor initial & date to confirm when corrected) - indicates deficient work which may be covered up after correction/completion, Contractor to initial confirming completion

⁵ Indicate who is to take action

⁶ Location of observation, e.g., room #, wall location, etc.

⁷ Observation #, usually keyed to the field review report no., i.e., 44.3 = 3rd observation at 44th field review. Useful for identifying when observation made, also when carrying forward to deficiency list.

⁸ Approvals to proceed are subject to any required approvals by others.

⁹ Some reviews are "work in progress", others are event driven, such as pre boarding or pre cladding. It may be useful to identify this.

¹⁰ Some reviewers like to record what's going on apart from their specific review scope.

¹¹ A place to note outstanding submittals, etc.

¹² A place to mention reminders, such as comments about upcoming weather conditions, general comments about performance, etc.

[Logo]

Field Review Report

©2000 [Company]. E&OE. Not to be reproduced without prior written consent. Unless notified within 24 hours, report contents accepted as correct. These comments regard the progress of the work and compliance with applicable codes, by-laws and construction documents. The Builder shall promptly notify the signator of this report for re-inspection when ready. The Builder remains responsible for the correction of deficient work, whether stated herein or not.

Project Name

Project Address

Our file #

Owner

Builder

Builder Site Rep.

Designer

[Other]

File name

9 field review pad/list.rtf - NOTE: Distribution is to those noted above u.o.n. below

--	--	--

Action 131415	By	Location	#	Date: ¹⁶	Outstanding Deficiencies ¹⁷¹⁸

¹³ **F** (Contractor fill in date when ready) - work requiring a Follow up Field Review is indicated with an unticked box and the "F-" prefix as shown here

¹⁴ **P** deficient work which may be covered up after correction, but of which the Contractor must take a picture illustrating the repair/completion, for presentation to us at the next meeting, is indicated with an unticked box and the "P-" prefix as shown here

¹⁵ **C** (Contractor initial & date to confirm when corrected) - indicates deficient work which may be covered up after correction/ completion, Contractor to initial confirming completion

¹⁶ Noting the date when the deficiency was observed is a means of identifying items which are lagging in correction.

¹⁷ The Contractor is responsible to call for re-review of deficient items before proceeding to cover.

¹⁸ This list floats separately from the field review report so it can be easily cut and pasted to other locations/ contexts.

[Logo]

Field Review Report

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Project Name Project Address Our file # Owner Builder Builder Site Rep. Designer [Other] File name	9 field review pad/list.rtf - NOTE: Distribution is to those noted above u.o.n. below
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Minimum List of Field Reviews (FR) required by Building Envelope Professional (BEP)¹⁹

FR by	Location/ Type ²⁰	Mock up ²¹ req'd	Level										
			P1	P2	1		2		3		4		ROOF
BEP	Fireplaces - air barrier continuity at penetrations ²²												
BEP	Fireplaces - insulation/ vapour barrier, pre-board												
BEP	Exterior wall moisture content - before v/b ²³												24
BEP	Exterior wall pre-board - insulation, v/b												
BEP	Substrate conditions for dampproofing/ waterproofing												
BEP	Dampproofing/ Waterproofing before cover ²⁵												
BEP	Waterproofing at grade between horizontal and vertical surfaces												

¹⁹ This table is our current template - will vary by project and practice.

²⁰ NOTE: This list includes minimum requirements for the CP/BEP only. Requirements for the Architect, Engineers and municipality are additional and the Contractor is responsible for determining those requirements

²¹ A mock-up of exterior wall conditions is always recommended for evaluation by the BEP, the Architect & Contractor. Boxes shaded mean these reviews/ elements are not usually included in the mock-up review process.

²² Submittal req'd - f/place generally for CP, details of proposed penetrations for BEP.

²³ For wood frame buildings only.

²⁴ Covers exterior walls of rooftop machine rooms, etc.

²⁵ Where the project includes later construction atop waterproofing, such as planter walls, stairs, etc., the BEP is to be called for a review prior to this superstructure work starting, to ascertain the condition of the substrate after preparation for superstructure. Submittal req'd - details of proposed waterproofing system materials to BEP.

[Logo]

Field Review Report

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Project Name Project Address Our file # Owner Builder Builder Site Rep. Designer [Other] File name	9 field review pad/list.rtf - NOTE: Distribution is to those noted above u.o.n. below
--	---

BEP	Vertical surfaces - prep. around penetrations ²⁶												
BEP	Penetrations - water testing of windows/ doors ²⁷												
BEP	Vertical surfaces - drainage cavity ²⁸												
BEP	Decks/balconies - surface prep. ²⁹												
BEP	Sloped roofing substrates and adjacent wall surfaces ³⁰												
BEP	Sloped roof finish ³¹												
BEP	"Flat" roof interfaces ³²												
BEP	"Flat" roof completion ³³												

- ²⁶ Includes windows, doors, fireplace flues, mechanical vents, etc. Submittal req'd - proposed self-adhering membranes (peel & stick) etc., to BEP
- ²⁷ A requirement for high-rise structures, highly recommended for low-rise. To be evaluated on a project-by-project basis.
- ²⁸ Includes continuity of air barrier, strapping installation, through wall flashings, sealing of miscellaneous penetrations such as staples, etc. Submittal req'd - details of proposed strapping, etc. to BEP.
- ²⁹ Includes deck moisture content (wood frame), "striping" of deck membrane reinforcing, required flashings, etc. Submittal req'd to BEP - proposed deck membrane system(s).
- ³⁰ Includes moisture content where applicable, air barrier continuity, underlying flashings, etc.
- ³¹ Includes examination of completed installation for ability to shed precipitation, etc.
- ³² Includes parapet and other abutting conditions, penetrations through roof such as skylights and mechanical vents, etc. Submittal req'd to BEP - proposed deck membrane system(s).
- ³³ Includes flashings, general workmanship, cleanup, etc.

CALIBRATION VERIFICATION <input type="checkbox"/>	
Equipment I. D.	
Calibrated by (initials):	Next calibration due: ____/____/____

EQUIPMENT IDENTIFICATION NO.						CALIBRATION INTERVAL WEEKS/MONTHS/YEARS	
------------------------------	--	--	--	--	--	---	--

DESCRIPTION		RANGE:	UPPER:
MANUFACTURE R			
DATE RECEIVED:			LOWER:
LOCATION			

[illegible]

[illegible]

- 1. Project Identification-
Address-

- ☒ • Accepted work is indicated with a ticked box like the one to the left of this comment.
- ☐ • Work not accepted or incomplete is indicated with an unticked box like the one to the left of this comment.
- ☐ • F_____ (Contractor fill in date when ready) - work requiring a Follow up Field Review is indicated with an unticked box and the "F-" prefix as shown here
- ☐ • P- deficient work which may be covered up after correction, but of which the Contractor must take a picture illustrating the repair/completion, for presentation to us at the next meeting, is indicated with an unticked box and the "P-" prefix as shown here
- ☐ • C_____ (Contractor initial & date to confirm when corrected) - indicates deficient work which may be covered up after correction/ completion, Contractor to initial confirming completion

☐ • PREVIOUS DEFICIENCIES REMAINING TO BE CORRECTED

- Field Review Notes

-

- [Date] Field Review

- 2. Field review conditions-

- Present-

[name]- arr dep

- Weather- sunny cloudy drizzle rain snow
Temperature- °C

- 3. Areas reviewed in detail- Note acceptable installations as well as deviations and deficiencies.

- - Empty -

- 4. Additional comments-

- Is project on schedule? Yes No

- Reason if behind schedule:

- Work in Progress during period?

- - Empty -

- 5. Follow up action(s) req'd -

- Items to be checked by other consultants:

- - Empty -

- List of Previous field reviews

- Previous deficiencies which have been corrected:

- - Empty -

- TOPICS FOR REVIEW

- AIR BARRIER

- CONTINUITY AT:

- Low slope interfaces (<1:12)

- Higher slope interfaces

- Higher slope interfaces
- Openings:
 - How achieved generally?
 - Back caulked window flange with Tyvek Homewrap taped over
 - continuous sealant bead between window frame and adjacent interior finish
 - sealant material?
 - Joint properly formed with rod & sealant bead?
 - Fill rt sealant bead?
 - Drainage channels remain open?
 - vapour barrier sealed onto air barrier with continuous sealant bead?
 - sealant material?
 - How achieved at window heads? (around head flashing) -
 - flashings end dammed and sealed? How?
 - Turned up flashing
 - Sealant end dam
 - Underside of flashing sealed? Material?
- Balconies
 - Tyvek Homewrap continuous between balcony & interior space - how?
 - Behind inside header where joists stop at header
 - Between joists at interface between exterior & interior space where joists penetrate from inside to outside.
 - Sealed to joists with what?
 - Tuck Tape
 - acoustical sealant
 - Other -
- Foundation/framing interface
 - Sill gasket? Material?
 - 3/16" polyethylene x sill width
 - Open cell gasket - type?
 - Other - specify:
 - From concrete through floor joists - specify method:
 - Around rim joist from subfloor to basement wall -
 - Other - specify:
- Strapping covers/fasteners:
- Strapping/fastener material
 - Fasteners hot dipped galvanized or stainless
- Drainage cavities screened?
 - Screen material:

- ☐
 - Strapping spacing:
 - MATERIAL(S) USED:
 - Strapping:
 - Air Barrier material:
 - Material(s) as approved?
 - LAP SEAL METHOD(S):
 - Workers using rollers on peel & stick - Yes No
 - Adequate time for peel & stick primer to flash? Yes No - estd time = min.
 - OKAY TO COVER: YES NO
- Cedar shakes
 - Materials
 - Premium or No. 1 grade
 - To CSA 0118.1
 - 100% edge grain
 - Min. 18" long.
 - Min. 4" wide & max. 14" wide
 - 3/8" < butt thickness < 1-1/4"
 - Flashings min. 26 ga. GI or .032" alum.
 - Sheathing
 - If Spaced sheathing
 - 1x4 min. (1x6) for 24" shakes
 - Pitch & exposure
 - Min 1:3
 - max. 2 ply roof exposures
 - 7-1/2" for 18"
 - 10" for 24"
 - max. 3 ply roof exposures
 - 5-1/2" for 18"
 - 7-1/2" for 24"
 - Application
 - Eave protection
 - 1 ply 30 min. Or 2 plies 15 min. Paper t@ 12" back of wall line
 - Shakes min. 1-1/2" o'hang at gutter
 - Typ. Course application
 - 18" wide strip of No. 15 felt @ top of each course.
 - Hips & ridges
 - Strip of No. 15 felt before cover
 - Valleys

- Min. 24" wide centre-crimped
- Underlaid by No. 15 felt.
- Shakes mitred intd valley (n@t broken)
- Flashings
 - At all vertical intersections
 - Min. 4" up & onto roof
 - Min. 3" around corners
 - Min. 3" headlap at stepped flashing
 - Vent flashings
 - Plastic vents min. 3" flange upslope & 2" flange downslope
 - Metal vents min. 4" flange & vert sealed hgt 3" min.
 - Plumbing vents min. 4" flange all sides
- Nails/ nailing
 - 2/shake h.d. Galvanized or SS type 304 or 316
 - To CSA B111
 - approximately 3/4" in from edges & 1-1/2" above butt line of next course
 - Flush & tight but not crushing wood
 - Type D power nails (h.d.) ok but no power staples or T nails
- Sidewalls
 - Single course Exposures
 - 8-1/2" for 18"
 - 11-1/2" for 24"
 - Nail 1" above butt line
 - Double course exposures
 - underlay of shakes or shingles
 - Max. 14" for 18" resawn shakes
 - Max. 20" with 24" resawn or taper-split shakes
 - For straight-split shakes 16" for 18' shakes/ 22" for 24" shakes
 - Nail 2" above butt line & 3/4" from edges
 - If shakes > 8" wide add 2 nails 1" apart across face
 - Corners
 - Outside corners c/w alternate overlaps
 - Inside corners mitred over metal flashing or 2 x2 over .flashing
- Damp proofing:
 - - extent visible/reviewed:
 - - when completed?
 - - general coverage
 - - air pockets filled? Yes No

- ☐
 - - tie holes trowelled over? Yes No
 - - Ok to cover subject to appl of others as req'd, i.e. Architect & Geotechnical Consultant? Yes No
- EIFS
 - Submittals
 - Basic system selected
 - Rainscreen
 - Non-rainscreen
 - Combustible
 - Noncombustible
 - Evidence of conformance to 15 min. test
 - Base coat consistent with system selected
 - Mesh specification consistent with system selected
 - Manufacturer's application instructions- project specific
 - Compatibility with other matls
 - Peel & stick
 - Waterproofing membranes
 - Selected Applicator information
 - Experience in area and with system
 - Shop drawings
 - Compartmentalization
 - Venting
 - Opening Prep details
 - Flashing details
 - Interfaces with openings
 - Doors
 - Windows
 - Mechanical openings
 - Locations of heavy duty mesh
 - Finish Colour
 - Preparation for Work
 - Correct hand tools present
 - Clean, potable water available
 - Raw materials stored under cover and out of cold temp
 - Scaffolding available and properly set up
 - Provision to repair any envelope penetrations
 - Application information/instructions available on site
 - Weather protection
 - Precipitation control - tarps

- ☐
 - Temperature control - min 4 deg C while curing
- Substrate Preparation
 - ☐ ▪ Dry when applying insulation layer with adhesive
 - ☐ ▪ Substrate not weathered/damaged
 - ☐ ▪ Generally suitable for EIFS application
- Insulation
 - ☐ ▪ Correct type/thickness
 - ☐ ▪ Density correct
 - Specified Provided
 - ☐ ▪ Insulation flat
 - ☐ ▪ Edges straight and square
 - ☐ ▪ Insulation well fused - few loose beads where broken
 - ☐ ▪ L-shaped pieces cut at corners of opngs
 - ☐ ▪ Grooves pre-cut
- Adhesive application to insulation
 - ☐ ▪ Correct adhesive pattern
 - ☐ ▪ Adhesive kept off end of insulation boards
- Installation with adhesive
 - ☐ ▪ Ins board joints not aligned with sheathing seams
 - ☐ ▪ Edges of boards tightly abutted
 - ☐ ▪ Boards aligned horizontally
 - ☐ ▪ Interlocking boards at outside corners
 - ☐ ▪ No adhesive between ins boards
 - ☐ ▪ Surface of insulation boards lines up
 - ☐ ▪ Pre-installed grooves, etc. line up
 - ☐ ▪ Space allowed at perimeter for sealant joints
- Finishing/Preparation of insulation surfaces
 - ☐ ▪ Rasp off any ridges between ins boards
 - ☐ ▪ Fill gaps betweenboards with ins sliver, not adhesive
 - ☐ ▪ Surface flat within tolerances
 - If not, sand
 - ☐ ▪ Perimeter of ins edge wrapped or back wrapped
- Reinforcing mesh
 - ☐ ▪ correct type / weight for application
 - Required =
 - ☐ ▪ Mesh cut to wall shape, allowing for overlaps
 - ☐ ▪ small mesh pieces ready for corners of openings
 - ☐ ▪ mesh pieces reverse rolled to eliminate curvature
 - ☐ ▪ heavy pieces ready for use on outside corners

- ☐ heavy pieces ready for use on outside corners
- ☐ Min. 2-1/2" lap
- ☐ Mesh fully embedded
- ☐ Field of the wall application
 - ☐ First adhesive, then mesh fully embedded
 - ☐ Min. 2-1/2" overlaps
 - ☐ Perimeter edge-wrapped or back-wrapped
 - ☐ Diagonal mesh at corners of openings
 - ☐ Heavy mesh first, then standard, at reinforced locations
 - ☐ Heavy mesh not overlapped (too heavy)
- ☐ Base Coat final inspection
 - ☐ Base coat surface smooth, no mesh pattern visible
 - ☐ Temperature >4 deg C
- ☐ Sealants
 - ☐ Acceptable types: silicone/ urethanes/ polysulfides
 - ☐ double rod and caulk at critical joints and high rises
 - ☐ correct joint width
 - ☐ mesh fully embedded at sealant areas
 - ☐ proper surface prep
 - ☐ correct temperatures for application
 - ☐ bond-to areas and/or bond breaker in proper position
 - ☐ closed cell backer rod
- ☐ FIRESTOPPING
 - ☐ Material(s) used:
 - ☐ Material(s) as approved?
 - ☐ Floors:
 - ☐ Sealant in place?
 - ☐ Ceilings
 - ☐ Batts in place?
 - ☐ Walls
 - ☐ Large penetrations sleeved & f'stopped?
 - ☐ Small penetrations taped or f'stopped
 - ☐ Cut top plates strapped?
 - ☐ Support continuity at drop clgs./duct runs & penetrations
- ☐ HLM 5000
 - ☐ Preparation:
 - ☐ Water on work areas:
 - ☐ Tarp cover:
 - ☐ Pre-stripping review:

- ☐
 - Pre-stripping review:
 - Reinforcing added at corners & hor/vert interfaces:
 - Reinforcing added between concrete & wood frame :
 - Reinforcing complete to inside of sill-to-jamb connection:
 - Reinforcing complete to 8" min. Above finished grade?
 - Base sheet:
 - Cont'd into sill opngs:
 - Cont'd min 12" up jambs:
 - Correct seam laps:
 - Adequate bleed-out:
 - Intermediate reinforcing:
 - Continuous:
 - Fully imbedded:
 - Top coat:
 - Full cover over reinforcement:
 - Protection board: Yes No - Matl.:
 - Insulation & vapour barrier
 - Area(s) reviewed
 - Exceptions
 - - Empty -
 - Okay to cover - YES NO
 - Moisture content tests 99.11.4
 - Area[s] reviewed/MC observed:
 - Floor sill plates -
 - Floor plywood sheathing (where not covered by topping)
 - Sheathing @ inside near floor line -
 - Sheathing at outside
 - Sheathing at centre ply
 - Window/opening sills -
 - Window/opening headers -
 - Inside ply
 - Outside ply
 - Holes drilled in header? Yes No - Where?
 - Outside sheathing
 - Outside ply
 - Other locations:
 - Okay to cover? Yes No
 - Comments:
 - Irrespective of moisture content, do not start ins/v.b. until bldg. windows, doors,

- ☐
 - Irrespective of moisture content, do not start ins/v.b. until bldg. windows, doors, soffits & Tyvek are in place and approved to cover.
- Urelastic 5000/6000 Walnut Shell Finish Pedestrian Deck
 - Materials:
 - ☐ ▪ del'd in unopened containers
 - ☒ ▪ Urelastic 5000 base coat
 - ☒ ▪ Urelastic 6000 top coat
 - ☐ ▪ Universal primer
 - Surface preparation
 - ☐ ▪ free of contamination, i.e., water, curing compounds, hardeners, bond-breakers, paint, etc.
 - ☐ ▪ Light broom finish rec'd for concrete
 - ☐ ▪ concrete water cured, not chemical cured
 - ☒ ▪ Remove contaminants by sandblasting, acid etching, etc.
 - ☒ ▪ Seal concrete cracks with Urelastic 230
 - ☒ ▪ Prime conc. surfaces with Universal concrete primer @ 350 sf/gal
 - ☐ ▪ Reinforce plywood seams and plywood to flashing seams with 4" w. strip of cloth tape embedded in Urelastic 5000, brushed over seam with app. 5" wide x 30 mils thick
 - ☐ ▪ Ok to apply product immediately over reinforcing.
 - Application
 - ☒ ▪ 5000 @ 60 sf/gal for 25 mil thickness x 2 coats (24 hr apart)
 - ☐ ▪ OR 1 @ 30 sf/gal (50 mils)
 - ☐ ▪ 6000 (10% shells) @ 70 sf/gal = 15 mils
 - ☐ ▪ Cure for 24 h min.
 - BALCONY EDGE DETAILING
 - ☒ ▪ Embed drip edge flashing into Ur 230 sealant
 - ☒ ▪ Run double reinforced UR 5000 over metal
 - PLYWOOD JOINT DETAILING
 - ☐ ▪ Caulk joints with Ur 230 sealant
 - ☐ ▪ Embed reinf tape into UR 5000, then coat over tape again
 - AGAINST BUILDING
 - ☒ ▪ Caulk top & bottom of cant strip with UR 230 sealant
 - ☒ ▪ Tape up wall min. 6" with UR 5000 and polyester tape
 - AT DOOR THRESHOLD
 - ☐ ▪ Run UR 5000 reinf withy polyester tape up and over door plate
 - ☒ ▪ End dam door sill by embedding sill into UR 230 sealant
 - AT DECK DRAINS
 - ☒ ▪ Run wet UR 5000 under deck drain flange & nail flange to wood deck
 - ☐ ▪ Reinf outside edge of drain flange & fasteners/penetrations with

- ☐
 - Reinf outside edge of derain flange & fasteners/penetrations with polyester tape & UR5000
- ☐
 - Plane ply 1/8" around deck flange for better drainage
- ☐
 - AT SCUPPER DRAINS/OVERFLOWS
 - Prime and sand any metal surface before coating
 - Run wet UR5000 under scupper flanges
 - Nail flanges to plywood
 - Fill visible gaps with UR 230 sealant
 - Reinforce all flange-to-plywood with UR 5000 & polyester tape
- ☐
 - SADDLE POINT AT PARAPET WALL TRANSITION
 - Run UR5000 min. 6" up wall and 2" onto parapet
- ☐
 - BALCONY/WALL INTERFACE (SADDLE)
 - Run reinf UR5000 min. 6" up wall, min. 4" onto sheathing.
- ☐
 - Vinyl siding
 - - Empty -
- ☐
 - Window review
 - Window model /installation method-
 - As spec'd?
 - Yes
 - No
 - Sill treatment. -
 - As spec'd?
 - Yes
 - No
 - Corner treatment -
 - Preformed gusset
 - ProtectoWrap
 - Other -
 - Built-up
 - Pin holes prevented by -
 - Sealant fillet
 - Matl -
 - Compatible w/ p/s?
 - Yes
 - No
 - Other - describe
 - ☐
 - Framing integrity
 - Moisture barrier
 - Material

- Continuity
- Opening preparation:
 - Peel and stick on sill, up jambs, lapped over paper below - yes no
 - Paper wrapped around head and jambs, into opng and back onto wall to first stud line -yes no
- Strapping
 - Material - PWF plywood - thickness - 5/8 in.
 - Drainage slots at bottom, esp. corners - yes no
- Sealant adhesion
 - Appears well adhered.
 - Rod & sealant detail
 - Fillet bead installation
 - Backcaulking
 - Between &
- Water penetration test
 - Test pressure -
 - B3 - 250 Mpa
 - Test results
 - Cycle 1 - 5 min
 - Cycle 2 - 5 min
 - Cycle 3 - 5 min
 - Cycle 4 - 5 min
 - Conclusion(s) -
 - Pass
 - Fail.
 - Leakage at
 - Glass/frame i'face
 - Sill
 - O'flow
 - Handles
 - Gaskets
- Air infiltration test
 - Head continuity - how?
 - Hilti-foam CF128
 - Installed 2 passes - yes no
 - Bond from window to framing matl (no sheathing paper).
 - Tooled.
 - Full coverage
 - Comments/exceptions -

- Sealant & Rod
 - Sealant matl -
 - Compatible with frame & framing? yes no
 - Tooled.
 - Full coverage
 - Comments/exceptions -
- Qualitative testing -
 - Leakage location(s) -
 - - Empty -
- Aesthetics
 - App'd by -
 - Architect
 - Owner rep
- Exterior door review
 - Door model(s) /installation method-
 - As spec'd?
 - Yes
 - No
 - Sill treatment. -
 - As spec'd? Yes no
 - Dbl sealant bed @ sill? Yes No
 - waterproofing membrane up & under sill? Yes No
 - Sill Corner treatment -
 - Preformed gusset
 - ProtectoWrap
 - Other -
 - Built-up
 - Pin holes prevented by -
 - Sealant fillet
 - Matl -
 - Compatible w/ p/s?
 - Yes
 - No
 - Other - describe
 - Framing integrity
 - Moisture barrier
 - Material
 - Tyvek Homewrap
 - building paper

- ☐
 - building paper
- ☐
 - Continuity
- ☒
 - Openingl preparation:
 - Paper wrapped around head and jambs, into opng and back onto wall to first stud line -yes no
 - Paper wrapped to outside edge only c/w Tuck Tape or peel & stick from frame onto paper
- ☒
 - Strapping
 - Material - PWF plywood - thickness - 3/8 1/2 5/8 3/4 in. Width - 1-1/2 2 2-1/2 in
 - Diagonal straps @jambs
- ☐
 - Sealant adhesion
 - Appears well adhered.
 - Rod & sealant detail
 - Fillet bead installation
 - Backcaulking
 - Between &
- ☒
 - Air infiltration test
 - Head continuity - how7
 - Hilti-foam CF128
 - Installed 2 passes - yes no
 - Bond from window to framing matl (no sheathing paper).
 - Tooled.
 - Full coverage
 - Comments/exceptions -
 - Sealant & Rod
 - Sealant matl -.
 - Compatible with frame & framing7 yes no
 - Tooled.
 - Full coverage
 - Comments/exceptions -
 - Qualitative testing -
 - Leakage location(s) -
 - - Empty -
- ☒
 - Aesthetics
 - App'd by -
 - Architect
 - Owner rep
- ☐
 - SBS roofing

- Primer -
- Materials
 - Base sheet -
 - Top sheet -
- Application -
- - Empty -



- The preceding are comments regarding progress of the work and compliance with applicable codes, bylaws and the contract.
- The contractor shall promptly correct deficient work and notify the writer of this report as requested above.
- The Contractor remains responsible for the correction of deficient work, whether stated herein or not.
-
- cc as Owner/Contractor/ Site/ Architects/ + Others noted as ACTION BY:
- Prepared by
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- Unless notified within 24 hours, we will assume the content of this message is accepted as correct. E&OE. Thank you.

TOPICS FOR REVIEW¹

AIR BARRIER

CONTINUITY AT:

Low slope interfaces (<1:12)

Higher slope interfaces

Openings:

How achieved generally?

Back caulked window flange with Tyvek Homewrap taped over continuous sealant bead between window frame and adjacent interior finish sealant material?

Joint properly formed with rod & sealant bead?

Fillrt sealant bead?

Drainage channels remain open?

vapour barrier sealed onto air barrier with continuous sealant bead? sealant material?

How achieved at window heads? (around head flashing) - flashings end dammed and sealed? How?

Turned up flashing

Sealant end dam

Underside of flashing sealed? Material?

Balconies

Tyvek Homewrap continuous between balcony & interior space - how?

Behind inside header where joists stop at header

Between joists at interface between exterior & interior space where joists penetrate from inside to outside.

Sealed to joists with what?

Tuck Tape

acoustical sealant

Other -

Foundation/framing interface

Sill gasket? Material?

3/16" polyethylene x sill width

Open cell gasket - type?

Other - specify:

From concrete through floor joists - specify method:

Around rim joist from subfloor to basement wall -

Other - specify:

Strapping covers/fasteners:

Strapping/fastener material

Fasteners hot dipped galvanized or stainless

Drainage cavities screened?

Screen material:

Strapping spacing:

MATERIAL(S) USED:

Strapping:

Air Barrier material:

Material(s) as approved?

LAP SEAL METHOD(S):

Workers using rollers on peel & stick - Yes No

Adequate time for peel & stick primer to flash? Yes No - estd time = min.

OKAY TO COVER: YES NO

Cedar shakes

Materials

Premium or No. 1 grade

To CSA 0118.1

100% edge grain

Min. 18" long

Min. 4" wide & max. 14" wide

3/8" < butt thickness < 1-1/4"

Flashings min. 26 ga. GI or .032" alum.

Sheathing

If Spaced sheathing

¹ NOTE: This checklist is copied from a Brainforest checklist installed on the author's Palm III. Much of the Brainforest formatting is lost, but the basic text and idea remains. The QAP also includes a pdf file showing full formatting.

1x4 min. (1x6) for 24" shakes

Pitch & exposure

Min 1:3

max. 2 ply roof .exposures

7-1/2" for 18"

10" for 24"

max. 3 ply roof .exposures

5-1/2" for 18"

7-1/2" for 24"

Application

Eave protection

1 ply 30 min. Or 2 plies 15 min. Paper t@ 12" back of .wall line

Shakes min. 1-1/2" o'hang at gutter

Typ. Course application

18" wide strip of No. 15 felt @ top of each course.

Hips & ridges

Strip of No. 15 felt before cover

Valleys

Min. 24" wide centre-crimped

Underlaid by No. 15 felt.

Shakes mitred intd valley (n@t broken)

Flashings

At all vertical intersections

Min. 4" up & onto roof

Min. 3" around corners

Min. 3" headlap at stepped flashing

Vent flashings

Plastic vents min. 3" flange upslope & 2" flange downslope

Metal vents min. 4" flange & vert sealed hgt 3" min.

Plumbing vents min. 4" flange all sides

Nails/ nailing

2/shake h.d. Galvanized or SS type 304 or 316

To CSA B111

approximately 3/4" in from edges & 1-1/2" above butt line of next course

Flush & tight but not crushing wood

Type D power nails (h.d.) ok but no power staples or T nails

Sidewalls

Single course Exposures

8-1/2" for 18"

11-1/2" for 24"

Nail 1" above butt line

Double course exposures

underlay of shakes or shingles

Max. 14" for 18" resawn shakes

Max. 20" with 24" resawn or taper-split shakes

For straight-split shakes 16" for 18" shakes/ 22" for 24" shakes

Nail 2" above butt line & 3/4" from edges

If shakes > 8" wide add 2 nails 1" apart across face

Corners

Outside corners c/w alternate overlaps

Inside corners mitred over metal flashing or 2 x2 over .flashing

Damp proofing:

- extent visible/reviewed:
- when completed?
- general coverage
- air pockets filled? Yes No
- tie holes trowelled over? Yes No
- Ok to cover subject to appl of others as req'd, i.e. Architect & Geotechnical Consultant? Yes No

EIFS

Submittals

Basic system selected

Rainscreen

Non-rainscreen

Combustible

Noncombustible

Evidence of conformance to 15 min. test

Base coat consistent with system selected

- Mesh specification consistent with system selected
- Manufacturer's application instructions- project specific
 - Compatibility with other matls
 - Peel & stick
 - Waterproofing membranes
- Selected Applicator information
 - Experience in area and with system
- Shop drawings
 - Compartmentalization
 - Venting
 - Opening Prep details
 - Flashing details
 - Interfaces with openings
 - Doors
 - Windows
 - Mechanical openings
 - Locations of heavy duty mesh

Finish Colour

Preparation for Work

- Correct hand tools present
- Clean, potable water available
- Raw materials stored under cover and out of cold temp
- Scaffolding available and properly set up
 - Provision to repair any envelope penetrations
- Application information/instructions available on site

Weather protection

- Precipitation control - tarps
- Temperature control - min 4 deg C while curing

Substrate Preparation

- Dry when applying insulation layer with adhesive
- Substrate not weathered/damaged
- Generally suitable for EIFS application

Insulation

- Correct type/thickness
- Density correct
 - Specified Provided
- Insulation flat
- Edges straight and square
- Insulation well fused - few loose beads where broken
- L-shaped pieces cut at corners of opngs
- Grooves pre-cut

Adhesive application to insulation

- Correct adhesive pattern
- Adhesive kept off end of insulation boards

Installation with adhesive

- Ins board joints not aligned with sheathing seams
- Edges of boards tightly abutted
- Boards aligned horizontally
- Interlocking boards at outside corners
- No adhesive between ins boards
- Surface of insulation boards lines up
- Pre-installed grooves, etc. line up
- Space allowed at perimeter for sealant joints

Finishing/Preparation of insulation surfaces

- Rasp off any ridges between ins boards
- Fill gaps betweenboards with ins sliver, not adhesive
- Surface flat within tolerances
 - If not, sand

- Perimeter of ins edge wrapped or back wrapped

Reinforcing mesh

- correct type / weight for application
 - Required =
 - Mesh cut to wall shape, allowing for overlaps
 - small mesh pieces ready for corners of openings
 - mesh pieces reverse rolled to eliminate curvature
 - heavy pieces ready for use on outside corners
 - Min. 2-1/2" lap

- Mesh fully embedded
- Field of the wall application
 - First adhesive, then mesh fully embedded
 - Min. 2-1/2" overlaps
 - Perimeter edge-wrapped or back-wrapped
 - Diagonal mesh at corners of openings
 - Heavy mesh first, then standard, at reinforced locations
 - Heavy mesh not overlapped (too heavy)
- Base Coat final inspection
 - Base coat surface smooth, no mesh pattern visible
 - Temperature ≥ 4 deg C
- Sealants
 - Acceptable types: silicone/ urethanes/ polysulfides
 - double rod and caulk at critical joints and high rises
 - correct joint width
 - mesh fully embedded at sealant areas
 - proper surface prep
 - correct temperatures for application
 - bond-to areas and/or bond breaker in proper position
 - closed cell backer rod
- FIRESTOPPING
 - Material(s) used:
 - Material(s) as approved?
 - Floors:
 - Sealant in place?
 - Ceilings
 - Batts in place?
 - Walls
 - Large penetrations sleeved & f'stopped?
 - Small penetrations taped or f'stopped
 - Cut top plates strapped?
 - Support continuity at drop clgs./duct runs & penetrations
- HLM 5000
 - Preparation:
 - Water on work areas:
 - Tarp cover:
 - Pre-stripping review:
 - Reinforcing added at corners & hor/vert interfaces:
 - Reinforcing added between concrete & wood frame :
 - Reinforcing complete to inside of sill-to-jamb connection:
 - Reinforcing complete to 8" min. Above finished grade?
 - Base sheet:
 - Cont'd into sill opngs:
 - Cont'd min 12" up jambs:
 - Correct seam laps:
 - Adequate bleed-out:
 - Intermediate reinforcing:
 - Continuous:
 - Fully imbedded:
 - Top coat:
 - Full cover over reinforcement:
 - Protection board: Yes No - Matl.:
- Insulation & vapour barrier
 - Area(s) reviewed
 - Exceptions
 - Okay to cover - YES NO
- Moisture content tests 99.11.4
 - Area[s] reviewed/MC observed:
 - Floor sill plates -
 - Floor plywood sheathing (where not covered by topping)
 - Sheathing @ inside near floor line -
 - Sheathing at outside
 - Sheathing at centre ply
 - Window/opening sills -
 - Window/opening headers -
 - Inside ply

Outside ply

Holes drilled in header? Yes No - Where?

Outside sheathing

Outside ply

Other locations:

Okay to cover? Yes No

Comments:

Irrespective of moisture content, do not start ins/v.b. until bldg. windows, doors, soffits & Tyvek are in place and approved to cover.

Urelastic 5000/6000 Walnut Shell Finish Pedestrian Deck

Materials:

del'd in unopened containers

Urelastic 5000 base coat

Urelastic 6000 top coat

Universal primer

Surface preparation

free of contamination, i.e., water, curing compounds, hardeners, bond-breakers, paint, etc.

Light broom finish rec'd for concrete

concrete water cured, not chemical cured

Remove contaminants by sandblasting, acid etching, etc.

Seal concrete cracks with Urelastic 230

Prime conc. surfaces with Universal concrete primer @ 350 sf/gal

Reinforce plywood seams and plywood to flashing seams with 4" w. strip of cloth tape

embedded in Urelastic 5000, brushed over seam with app. 5" wide x 30 mils thick

Ok to apply product immediately over reinforcing.

Application

5000 @ 60 sf/gal for 25 mil thickness x 2 coats (24 hr apart)

OR 1@ 30 sf/gal (50 mils)

6000 (10% shells) @ 70 sf/gal = 15 mils

Cure for 24 h min.

BALCONY EDGE DETAILING

Embed drip edge flashing into Ur 230 sealant

Run double reinforced UR 5000 over metal

PLYWOOD JOINT DETAILING

Caulk joints with Ur 230 sealant

Embed reinf tape into UR 5000, then coat over tape again

AGAINST BUILDING

Caulk top & bottom of cant strip with UR 230 sealant

Tape up wall min. 6" with UR 5000 and polyester tape

AT DOOR THRESHOLD

Run UR 5000 reinf withy polyester tape up and over door plate

End dam door sill by embedding sill into UR 230 sealant

AT DECK DRAINS

Run wet UR 5000 under deck drain flange & nail flange to wood deck

Reinf outside edge of drain flange & fasteners/penetrations with polyester tape & UR5000

Plane ply 1/8" around deck flange for better drainage

AT SCUPPER DRAINS/OVERFLOWS

Prime and sand any metal surface before coating

Run wet UR5000 under scupper flanges

Nail flanges to plywood

Fill visible gaps with UR 230 sealant

Reinforce all flange-to-plywood with UR 5000 & polyester tape

SADDLE POINT AT PARAPET WALL TRANSITION

Run UR5000 min. 6" up wall and 2" onto parapet

BALCONY/WALL INTERFACE (SADDLE)

Run reinf UR5000 min. 6" up wall, min. 4" onto sheathing.

Vinyl siding

Window review

Window model /installation method-

As spec'd?

Yes

No

Sill treatment. -

As spec'd?

Yes

No

Corner treatment -

Preformed gusset

ProtectoWrap

Other -

Built-up

Pin holes prevented by -

Sealant fillet

Matl -

Compatible w/ p/s?

Yes

No

Other - describe

Framing integrity

Moisture barrier

Material

Continuity

Opening preparation:

Peel and stick on sill, up jambs, lapped over paper below - yes no

Paper wrapped around head and jambs, into opng and back onto wall to first stud line

-yes no

Strapping

Material - PWF plywood - thickness - 5/8 in.

Drainage slots at bottom, esp. corners - yes no

Sealant adhesion

Appears well adhered.

Rod & sealant detail

Fillet bead installation

Backcaulking

Between &

Water penetration test

Test pressure -

B3 - 250 Mpa

Test results

Cycle 1 - 5 min

Cycle 2 - 5 min

Cycle 3 - 5 min

Cycle 4 - 5 min

Conclusion(s) -

Pass

Fail.

Leakage at

Glass/frame i'face

Sill

O'flow

Handles

Gaskets

Air infiltration test

Head continuity - how?

Hilti-foam CF128

Installed 2 passes - yes no

Bond from window to framing matl (no sheathing paper).

Tooled.

Full coverage

Comments/exceptions -

Sealant & Rod

Sealant matl -

Compatible with frame & framing? yes no

Tooled.

Full coverage

Comments/exceptions -

Qualitative testing -

Leakage location(s) -

Aesthetics

App'd by -

Architect

Owner rep

Exterior door review

Door model(s) /installation method-

As spec'd?

Yes

No

Sill treatment. -

As spec'd? Yes no

Dbl sealant bed @ sill? Yes No

waterproofing membrane up & under sill? Yes No

Sill Corner treatment -

Preformed gusset

ProtectoWrap

Other -

Built-up

Pin holes prevented by -

Sealant fillet

Matl -

Compatible w/ p/s?

Yes

No

Other - describe

Framing integrity

Moisture barrier

Material

Tyvek Homewrap

building paper

Continuity

Opening preparation:

Paper wrapped around head and jambs, into opng and back onto wall to first stud line

-yes no

Paper wrapped to outside edge only c/w Tuck Tape or peel & stick from frame onto paper

Strapping

Material - PWF plywood - thickness - 3/8 1/2 5/8 3/4 in. Width - 1-1/2 2 2-1/2 in

Diagonal straps @jambs

Sealant adhesion

Appears well adhered.

Rod & sealant detail

Fillet bead installation

Backcaulking

Between &

Air infiltration test

Head continuity - how?

Hilti-foam CF128

Installed 2 passes - yes no

Bond from window to framing matl (no sheathing paper).

Tooled.

Full coverage

Comments/exceptions -

Sealant & Rod

Sealant matl -

Compatible with frame & framing? yes no

Tooled.

Full coverage

Comments/exceptions -

Qualitative testing -

Leakage location(s) -

Aesthetics

App'd by -

Architect

Owner rep

SBS roofing

Primer -

Materials

Base sheet -

Top sheet -

Application -