SECTION  – building envelope inspection and testing

1. General
   1. summary
      1. This Section is included for the information of the Contractor and Building Envelope Consultants, so that they can coordinate their activities with the Owner's inspection and testing agency; costs for inspection and testing will be paid for by the Owner from a Cash Allowance; Contractor and Subcontractors shall include coordination costs only, do not include any costs for actual inspection and testing.
      2. Intent of this Section is to provide requirements for periodic building envelope inspections (not full-time inspection) for duration of building envelope installation, with building envelope inspector providing site specific recommendations and corrections to deficient materials or workmanship, and recording observations, recommendations and corrections on a timely basis.
      3. This Section specifies inspection and testing of building envelope assemblies including membranes, transitions between envelope components, penetrations, insulation installation, doors and windows including, but not limited to, the following:

SPEC NOTE: Pre‑construction review services are essential to achieving good or best building envelope practices, and for determining whether there is a risk for conditions that could lead to the development of mould. Delete all references in this document to best building envelope practices where a building envelope consultant has not reviewed the documents prior to them being issued for bid.

* + - 1. Pre-Construction Services:
         1. Review Consultant's drawings, details and specifications and make recommendations for changes in materials or design of building envelope relating to constructability and conformance with best building envelope practice.
      2. Construction Coordination:
         1. Consultant will provide a complete set of construction documents, shop drawings and site instructions relating to the scope of work covered by this Section to the Building Envelope Inspector for their use in reviewing the construction.
         2. Attend and coordinate building envelope pre installation meetings and inform participants of expectations for building envelope installation and performance.
         3. Make recommendations to Consultant for corrective measures where materials are installed incorrectly.
         4. Confirm that recommend corrective measures are completed as installation progresses; obtain confirmation from Contractor that repairs are completed where the Building Envelope Inspector cannot make direct observation.
      3. Air and Vapour Membranes:
         1. Confirm that membrane materials and installation are adequate to control air, vapour, and moisture penetration in accordance with manufacturer's instructions best building envelope practices.
         2. Confirm tightness of air and vapour seal after installation of wall and roof membranes, and transitions between doors and windows by smoke candle observation.
         3. Verify performance of building air seal after completion of building envelope by pressure testing and recording pressure drops; note difference between actual measurement and theoretical achievable measurement.
    1. Insulation:
       1. Confirm that insulation is installed to specified values; that insulation is installed continuously; and that thermal breaks are adequately treated to reduce the potential for formation of condensation within the building envelope.
       2. Verify completeness and effectiveness of building insulation using infrared (IR) scanning and recording equipment.
    2. Glazing:
       1. Confirm that National Fenestration Rating Council (NFRC) ratings on windows are met for specified U value and Specific Heat Gain Coefficients (SHGC) specified in Section 08 80 00 - Glazing.
       2. Confirm that Low E coatings on windows are installed on the correct surface.
    3. Record Keeping:
       1. Record findings and report to Consultant, Owner and Contractor during the progress of the Work.
       2. Summarize report findings for final submission including confirmation of corrective actions recommended for installed Work.
       3. Obtain records from Contractor confirming completion of corrective measures where work is covered up between regularly scheduled site visits.
    4. Related Requirements:
       1. Section 01 21 00 – Allowances. Cash Allowance for testing and inspection administered by the Contractor and reviewed by the Consultant.
       2. Section 07 08 50 – Membrane Roofing Inspection and Testing.
       3. Section 07 21 13 – Board Insulation.
       4. Section 07 21 16 – Blanket Insulation.
       5. Section 07 26 13 – Above Grade Vapour Retarders.
       6. Section 07 27 39 – Vapour Permeable Air Barrier Membrane.
       7. Section 07 42 13 – Metal Wall Panels.
       8. Section 07 52 16.13 – SBS Modified Bituminous Membrane Roofing - Mop/Torch.
       9. Section 07 54 23 – Thermoplastic Polyolefin Roofing (TPO).
       10. Section 07 55 56.13 – Hot-Applied Rubberized Asphalt Protected Membrane Roofing."
       11. Section 07 62 00 – Prefinished Metal Flashing and Trim.
       12. Section 07 92 00 – Joint Sealants.
       13. Section 08 11 13 – Steel Doors and Frames.
       14. Section 08 41 13 – Aluminum Framed Entrances and Storefronts.
       15. Section 08 42 29 – Aluminum Entrance Sliding Doors.
       16. Section 08 44 13 – Glazed Aluminum Curtain Wall.
       17. Section 08 53 13.13 – Vinyl Windows and Patio Doors.
       18. Section 08 80 00 – Glazing.
  1. definitions
     1. Building Envelope Inspector: A professional engineer, architect or technologist having specific experience in building envelope science, and who has a minimum of five (5) years of experience with work similar to that of the Project; following additional definitions relate to the scope of work for the Building Envelope Inspector:
        1. Best Building Envelope Practice: Recommended construction procedures, methods and materials that enhance the air tightness, moisture resistance and water vapour control of the building envelope as researched and tested by the National Research Council of Canada; Canada Mortgage and Housing Corporation; or other recognized building envelope research organization.
        2. Verify: Recording of detailed review and testing of installed materials to ascertain specified performance criteria.
        3. Confirm: Recording of observations of installed materials and comparison to technical specifications, manufacturer's literature to ascertain conformance with established building envelope practices.
  2. reference standards
     1. American Society for Testing and Materials (ASTM):
        1. ASTM E 283 91(1999), Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
        2. ASTM E 779 03, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
     2. Canadian General Standards Board (CGSB):
        1. CAN/CGSB 149 GP 2MP, Manual for Thermographic Analysis of Building Enclosures.
        2. CAN/CGSB 149.10 M86, Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method.
        3. CAN/CGSB 149.15 96, Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method using the Building's Air Handling Systems.
     3. National Fenestration Rating Council (NFRC):
        1. NFRC 100 2001: Procedures for Determining Fenestration Product U Factors.
        2. NFRC 102 2002: Test Procedure for Measuring the Steady State Thermal Transmittance of Fenestration Systems.
        3. NFRC 200 2001: Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence, including current addenda.
  3. QUALITY ASSURANCE
     1. Submit qualifications when requested by Consultant indicating the following:
        1. Proof of membership in good standing of a recognized building envelope association.
        2. Proof of experience in all aspects of the required work and be familiar with specified building envelope materials.
        3. Proof of experience as a Building Envelope Inspector covering a minimum time period of five (5) years.
        4. Listing of applicable training or educational programs relating to building envelope design and inspection.
     2. Building Envelope Inspector shall be independent from Contractor and building envelope Subcontractors.
  4. submittals
     1. Inspection Reports:
        1. Submit inspection reports on a weekly basis in accordance with Article 2.1 below; submit copies of reports to:
           1. Owner.
           2. Consultant.
           3. Contractor, who will distribute copies to the affected building envelope. Subcontractors.
        2. Notify Consultant and Owner of noncompliant workmanship or materials and recommended corrective action within one (1) day of discovery.
     2. Letter of Conformance:
        1. Submit Letter of Conformance to Consultant in accordance with Section 01 33 00 – Submittal Procedures, stating a belief that materials and methods used for construction meets requirements of manufacturer's instructions best building envelope practices and design intent indicated in Consultants documents, and are in substantial conformance with the requirements of the Building Code.
        2. Summarize Building Envelope Inspection activities performed during the progress of the Work; signed by Building Envelope Inspector responsible for inspection and testing program.
     3. Progress Payments:
        1. Prepare detailed monthly invoices and submit to Contractor for administration of Cash Allowance for inspection and testing in accordance with Section 01 21 00 - Allowances.

1. Products
   1. reports
      1. Maintain a weekly log of events, observations and recommendations, deficiencies, and corrective instructions, and submit as directed in Subparagraph 1.6.1.1 above.
      2. Terms of reference for inspection and testing services for building envelope membranes include:
         1. Review and reporting of drawings, details and specifications for compliance with manufacturer's instructions and best building envelope practices, and as follows:
            1. Provide suggested modifications to Consultant's documents and manufacturer's standard details (if any) required for compliance with manufacturer's instructions and best building envelope practices.
            2. Coordinate a preinstallation meeting with Consultant, Contractor and building envelope Subcontractors to discuss any modifications to documents required for compliance with detailed drawing requirements, manufacturer's instructions and best building envelope practices.
         2. Review and report on going building envelope work relating to substrate preparation, installation of air and vapour membranes, insulation, building envelope accessories, window, doorframes and penetrations, flashings, membrane flashings and membranes; coordinate with Contractor for estimated time span of building envelope operations.
         3. Building Envelope Inspector is responsible for weekly review of work and reporting compliance during progress of the work at regularly scheduled intervals, unless the Client has requested more frequent reviews, or unless the Building Envelope Inspector determines that more frequent reviews are required.
         4. Responsibility for quality of construction and compliance with Contract Documents rests solely with Contractor.
         5. Consultant will make all engineering decisions with respect to rejection criteria and rework required.
         6. Copies of building envelope inspection reports shall be addressed to Owner with copies sent to Consultant, Contractor, and building envelope Subcontractors.
   2. building envelope mock-up
      1. Coordinate construction of a mock up on site at location determined by Consultant of typical wall assembly consisting of wall structure and substrates, air and vapour membranes, transition membranes, penetrations, doors, and windows in accordance with Section 01 45 00 – Quality Control.
      2. Mock up shall have a sealed interior compartment capable of replicating expected interior conditions and pressure differential.
2. Execution
   1. inspection and testing: general
      1. It is the responsibility of Contractor to notify Building Envelope Inspector regarding timing of inspection and testing with respect to the Construction Schedule.
      2. Building Envelope Inspector shall coordinate with Contractor's schedule and make themselves aware of the current work schedule and bring to the attention of Consultant and Contractor any inspection or testing requirement apparently being overlooked.
      3. Immediately inform Consultant and seek instructions where Building Envelope Inspector recommends additional inspection or testing beyond that stipulated in this scope of service.
      4. Immediately inform Consultant where site conditions are such that a reduced program of inspection and testing is deemed appropriate.
   2. initial inspection
      1. Confirm that materials being used for project are as specified.
      2. Confirm that construction and materials are in conformance with manufacturer's instructions.
      3. Conduct review of substrates, comment on condition and acceptability for specified building envelope membranes.
      4. Conduct a pre installation meeting and coordinate manufacturer's written instructions with Subcontractors affected by building envelope work.
      5. Record observations and instructions, clarifications and corrective actions stated during pre installation meeting and initial review and distribute copies as noted in Subparagraph 1.6.1.1 above.
   3. interim inspections
      1. Conduct on going weekly reviews of work progress, recording progress and deficiencies, and written instructions, clarifications or corrective actions required by building envelope Subcontractors, and as follows:
         1. Record weather conditions.
         2. Record names and certificate numbers of Registered Torch Applicators, where torch applied membranes are specified.
         3. Prepare plan indicating work completed on day of observation.
         4. Confirm that building envelope materials, flashings, building envelope accessories and ancillary materials are in accordance with specification and manufacturer's requirements.
         5. Perform periodic smoke candle testing as work progresses and verify that building envelope membrane is being installed in accordance with manufacturers requirements and best building envelope practice.
      2. Record observations and instructions, clarifications and corrective actions stated during interim inspections and distribute copies as noted in Subparagraph 1.6.1.1 above.
      3. Coordinate number of required interim reviews with building envelope Subcontractor's work schedule as approved by Contractor.
   4. PERFORMANCE TESTING: BUILDING ENVELOPE MOCK UP
      1. Test mock up for wind, air and water infiltration and confirm that proposed building envelope assembly meets or exceeds expected performance criteria for best building envelope practice.
      2. Maintain a record of details used to construct mock up including any modification required to meet performance criteria; inform Contractor and building envelope Subcontractors of results of mock up and methods that they can incorporate into the Work to maintain best building envelope practice established by the mock up.
      3. Remove mock up when directed by the Consultant.
   5. PERFORMANCE TESTING: THERMAL CONTINUITY
      1. Perform infrared thermographic scan of building and verify continuity of building insulation system in accordance with CGSB 149 GP 2MP.
      2. Maintain a photographic record of deficiencies observed during infrared thermographic scans and make recommendations for corrective construction and distribute copies as noted in Subparagraph 1.6.1.1 above.
   6. PERFORMANCE TESTING: AIR TIGHTNESS

SPEC NOTE: Determine which test method will be used by the Owners Building Envelope Inspection Agency and include appropriate reference in this Item. Delete standards from Article 1.4 above that will not be used for this project.

* + 1. Perform smoke candle testing in locations determined by the Consultant after completion of building envelope and confirm continuity of building envelope air membrane seal.
    2. Perform building pressurization test in accordance with CGSB 149.15 and perform building depressurization test in accordance with CGSB 149.10, after completion of building envelope to verify continuity of building envelope air membrane seal.
    3. Maintain a record of observations and make recommendations for corrective construction to the Owner, Consultant and Contractor.
  1. INSPECTIONS OF PREFABRICATED UNITS
     1. Review materials fabricated off site at place of manufacture; fabricated materials include, but are not limited to, the following:
        1. Precast concrete panels.
        2. Masonry.
        3. Prefabricated cladding and panel systems.
        4. Sealed glass units.
        5. Prefabricated window units.
        6. Curtain wall glazing systems.
     2. Maintain a record of observations and make recommendations for corrective construction and distribute copies as noted in Subparagraph 1.6.1.1 above and to affected fabricator.
  2. final inspection
     1. Prepare deficiency list indicating corrective measures required and any hold back amounts required where corrective measures are not forthcoming.
     2. Record observations and instructions and make final submission listing outstanding repairs.
     3. Submit a Letter of Conformance in accordance with Paragraph 1.6.2 above.
  3. ADDITIONAL INSPECTION AND TESTING
     1. Additional inspections, reviews or testing shall be conducted only as instructed by Owner.
     2. No costs for extra work will be accepted unless pre-approved by Owner.

END OF SECTION