07 00 00 Thermal and Moisture Protection

07 51 00 Built-Up Bituminous Roofing

General

Description of the Work:

Basic Scope:

.1 For new roofs, ensure that all roofs are accessible by roof hatches, operable/lockable windows, stairs or ladders.

.2 For new and existing roofing projects, ensure that there are fixed railings to protect where foot traffic for access and service must approach within 2.0 m (6'-6") from a roof edge. This Consultant shall engineer the railing system and not pass that task to the Contractor.

.3 For new and existing roofing, ensure that skylights that have sills less than 42" above the roof are provided with guards to prevent falling onto (and through) the skylights – or equal protection.

.4 If premanufactured guards are proposed to be used, the engineering and design of same must be reviewed by the Consultant to confirm that the supplier data is accepted as sound for the purposes at hand.

.5 If the only solution feasible for protection is the use of fall arrest equipment, such as a fixed life line and anchors, this Consultant shall fully design and engineer same system. Where possible, utilize anchors set to walls in lieu of anchors set to the roofing.

.6 Ensure that all conduit trays, piping and ducting in the completed roofing that must be crossed by service personal are provided with safe steps/bridges and other means of passage. In some cases, where elevators and/or gas-fired equipment must be serviced, TSSA requirements should be considered. Improved lighting could be required to ensure safe trafficking of a roof at night for emergency service.

.7 Identify the roofs by alpha and/or numeric references. Include gross area of each roof denoting if the measure if to the inside (preferred) or outside of the curbs. Include reference to perimeter lengths to aid bidders in assessing curb flashings. Identify if measurements are from site measurement, or record drawing measurements.

.8 The line below pertains not to the common "Related Sections" sentence but rather to information to be highlighted to bidders as to special coordination requirements. This could include special lifting of mechanical equipment, potential shut-downs needed due to exhaust fumes, known special events, etc.

Coordinate with Project Manager

.9 All other requirements of the Work are as specified and/or as noted on the Drawings.

Qualifications:

.1 PPS/Queen's have a strict requirement for roofers as either prime or sub-contract contractors to comply with the following.

.2 The roofer shall be a member in good standing in the OIRCA and/or the CRCA.
.3 All workers for this Section shall be employees of the roofer and not sub-contractors, independent contractors, or otherwise.
.4 The full-time working foreman and lead-hand of the roofing crew shall have no less than 10 years verifiable experience in 4-ply built-up asphalt roofing.
.5 Sheet metal workers shall have no less than 5 years verifiable experience in the fabrication and installation of roofing sheet metal and shall be fully knowledgeable of the standards set out in SMACNA manual.
.6 The roofer must specifically carry open-flame insurance as part of their roofing insurance coverage.

Warranty:

.1 The roofing contractor associations limit warranties to 2 years. Longer warranties, such as 15-year or 20-year, can be available for some roof types through the manufacturer – the manufacturer will often in turn secure the contractor's warranty to them. Same warranties generally require that only products from the main product manufacturer can be used whereas PPS/Queen's would seek to incorporate some alternative products where experience shows improved performance is available. PPS/Queen's have been getting reliable and low-maintenance 30-year to 40-year performance out of 4-ply asphalt built-up roofing systems, so the length of the warranty is less a concern than the quality of the work.
.2 The Contractor shall warrant all labour and workmanship, complete, so as to ensure the soundness and continued watertightness of the completed Work for a period of two (2) years.
.3 The roofing warranty document shall be the standard OIRCA or CRCA warranty duly executed by the member roofer and provided to the Owner.
.4 Warranty requirements also include the proper performance of the prepainted metal as follows.
.5 This shall include the manufacturer's 40-year limited warranty (equal to or exceeding that provided with VicWest WeatherX, or Agway/Andex "Pre-painted Perspectra Series Coated Steel").
.6 This shall include for 2 years for the complete wind-tight security of the metal flashings.
.7 For larger projects, cross reference the related Sections. This could be for Metal Flashings and Trim, other Roofing Sections, etc.

Reference Standards:

.1 The following 2 sub-sentences are the most important as the referenced documents are inclusive.
- Except where explicit directions are given in the Contract documents, do all roofing work in accordance with applicable CRCA and NRCA standards as set forth in the CRCA Roofing Specifications Manual and applicable NRCA manuals.
- Except where explicit directions are given in the Contract documents, do all sheet metal work in accordance with applicable SMACNA and/or CDA standards.

.2 Delete all inapplicable sub-sentences – which is expected to be most of the sub-sentences.

ASTM International Inc.

- ASTM C726-[05], Standard Specification for Mineral Fiber Roof Insulation Board.
- ASTM C728-[05], Standard Specification for Perlite Thermal Insulation Board.
- ASTM C1002-[07], Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- ASTM C1177/C1177M-[06], Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- ASTM C1396/C1396M-[06a], Standard Specification for Gypsum Board.
- ASTM D41-[05], Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- ASTM D226-[06], Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- ASTM D312-[00(2006)], Standard Specification for Asphalt Used in Roofing.
- ASTM D448-[03a], Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- ASTM D450-[07], Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.
- ASTM D1863-[05], Standard Specification for Mineral Aggregate Used on Built-Up Roofs.
- ASTM D2178-[04], Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
- ASTM D4601-[04], Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
- ASTM D6380-[03], Standard Specification for Asphalt Roll Roofing (Organic Felt).

Canadian General Standards Board (CGSB)

- CGSB 37-GP-9Ma-[83], Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

Canada Green Building Council (CaGBC)

- LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

Canadian Standards Association (CSA International)

- CSA A123.2-[03], Asphalt-Coated Roofing Sheets.
- CSA A123.3-[05], Asphalt Saturated Organic Roofing Felt.
- CSA A123.4-[04], Asphalt for Constructing Built-Up Roof Coverings Waterproofing Systems.

- CSA A123.16-[04], Asphalt-Coated Glass Base Sheet.
- CSA A123.17-[05], Asphalt Glass Felt Used for Roofing and Waterproofing.
- CSA A123.21-[04], Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- CSA A231.1-[06], Precast Concrete Paving Slabs.
- CAN/CSA-ISO 9001-[00], Quality Management Systems - Requirements.
- CAN/CSA-ISO 14001-[04], Environmental Management Systems - Requirements with Guidance for Use.
- CSA O121-[08], Douglas Fir Plywood.

CSA O151-[04], Canadian Softwood Plywood

- Canadian Roofing Contractors' Association (CRCA)
- CRCA Roofing Specifications Manual - [1997].

Factory Mutual (FM Global)

Note: Reference to FM approvals requires that the Consultant have comprehensive knowledge of same standards and how specified materials/assemblies must exactly match tested assemblies – which are not likely to be those in use on many PPS/Queen's projects. This is not something for the Contractor to have any role in as to levels, components, assemblies, etc. DELETE Factory Mutual if it is not to be used.

- FM Approvals - Roofing Products.

Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- Material Safety Data Sheets (MSDS).

Underwriters' Laboratories of Canada (ULC)

- CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- CAN/ULC-S702.2-[03], Standard for Mineral Fibre Thermal Insulation for Buildings.
- CAN/ULC-S704-[03], Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- CAN/ULC-S706-[02], Standard for Wood Fibre Thermal Insulation for Buildings.

Environmental Requirements:

.1 Conduct Work only during dry weather conditions and as set forth to be satisfactory herein and to the membrane and roofing materials suppliers.
.2 Ensure that all materials introduced to the roofing system are dry, clean and undamaged.

Delivery, Storage and Handling:

.1 All products delivered to the site shall be as set out in the Specifications or otherwise as explicitly approved in writing by the Consultant in advance of delivery to the site.

.2 All products shall be stored with labels in place.
- Weigh bills shall be provided upon delivery of products that inherently do not have labels (such as pea stone, etc.).

.3 Roof insulation must be protected and stored secure from wind blow off and undue weathering, wetting of edges, warping, edge damage, etc.

.4 Membrane rolls should be stored on end with adequate supports.
- Membrane rolls must be maintained above any moisture that could impact the rolls including rain, snow and splash.

.5 Store adhesives and caulking in sealed, labeled containers and at temperatures above +5C.
- Do not store flammable products in Queen's buildings, penthouses, etc.

.6 All board goods (insulation, fibreboard, gypsum sheathing, plywood, etc.) and all lumber products must be tarped with breathable water repellant covers and kept on raised sleepers during storage.
- Do not store under polyethylene or other non-breathable covers that will subject covered products to wetting from condensation.

Protection:

.1 Seal the perimeters of the membrane at the end of each working day to prevent water infiltration into the roof system and/or building.

.2 At no time are perimeter wood curbs, or other woodwork, be left exposed to direct or indirect weathering.
- All woodwork MUST be protected with roofing materials, not polyethylene, the same day that the woodwork is installed.

.3 Adequate care shall be taken by all trades to protect the installed membrane from damage.
- MUST be taken to not traffic across fresh BUR.

.4 Protect the building interior and adjacent exterior surfaces from damage, asphalt, staining.

Submittals:

.1 Products:
- Submit product data sheets only if being alternatives approved from those listed herein.
- If high density tapered (or uniform thickness) fibreboard is to be used in the Work, include product data sheets in advance to ordering product.

.2 Schedule:
- Provide a detailed update of the roofing portion of the project schedule as submitted with the project tender.
  - Include reference to crew size, working foreman, lead-hand, etc.
  - Make clear indication as to when and where mechanical and electrical equipment will need to be out of service in a manner satisfactory to the Owner's operations.

- Make clear indication as to when and where sheet metal work will commence with clear indications as to working periods required to reach completion.
- Site clean-up and staging will be reviewed and coordinated to minimize impact.
- Identify all areas of coordination with other trades and with the Owners and make note of all potential interruptions of service, shut-downs.

- 1.8.2.2 Provide a proposed breakdown of components of the Work for progress billing purposes.
  - Include: (Edit to suit job requirements.)
  - Bonds, insurance, Permit(s);
  - Mobilization, site protection, site access, crane, light standards relocated, temporary security lighting, walk-through scaffold to all entry and exit locations.
  - Hazardous materials abatement, disposal.
  - Roof demolition, tear-off, disposal, recycling.
  - Vapor barrier (transitions), carpentry, curb insulation;
  - Raising of door thresholds where existing are low;
  - Raising of skylights (curbs) where existing are low;
  - Life safety anchors, railing bases, roof hatches.
  - Duct removal and preparation.
  - Roof membrane installation, drains, mechanical and electrical.
  - Roof insulation and ballasting, pavers.
  - Sheet metal flashings.
  - Completion of railings.
  - Penthouse cladding.
  - Final cleaning, as-built drawing preparation and submittals, O&M manual submittals.
  - Demobilization, site restoration including hard and soft landscape, etc.

.3 **Samples:**

- 1.8.3.1 Metal Colour(s):
  - Upon commencing the project, submit one (1) actual sample of each colour of sheet metal required to be used in the Work.
  - Samples shall be minimum 1½" x 3".
  - Provide confirmation of the paint/coating grade and the gauge of the base metal to be supplied.
  - Include supplier name.
  - Include sample 40-year warranty.

.4 **Shop Drawings, Sketches, and/or Mock-ups:**

- For sheet metal Work, shop drawings or sketches should be provided upon commencing roofing Work.
- If upon review with the Contractor the Consultant provides written acceptance that mock-ups can be provided in lieu of drawings/sketches, then same shall be prepared, revised as needed, and accepted by the Consultant before sheet metal fabrication commences.

- If a mock-up is being done to show assembly of components, but the colour and/or base metal thickness/type does not exactly match the specifications, then Consultant approval, if given, is limited solely to the general assembly and not to metal, thickness, coating product, colour, etc.

.5 **Products:**

- Submit full listing of products to be provided.
  - Where same match the specifications, include only in list format, do not include Product Data sheets at this stage.
  - Include the listing of fasteners.

- Alternate Products:
  - It is not expected that alternate products will be provided or proposed.
  - The Contractor shall be certain to allow time and resources to secure all specified products for on-time delivery.
  - Confirm below the Division 1 Section number applicable.
  - If circumstances of delivery, or manufacturing problems, etc., arise beyond the control of the Contractor, and not being due to late or inadequate planning, then submittals for Alternates shall be as set out in Section 01 33 00, Submittal Procedures.
  - Submittals must include clean Product Data sheets for specified and proposed alternative products.
  - Submittals must show clear reference to the proposed products matching specified product performance data and characteristics.
  - Submittals must show the cost variance information including supplier invoices upon demand by the Consultant.
  - Upon demand by the Consultant, the Contractor shall provide physical samples of the alternate products being proposed.

.6 **MSDS:**

- Provide MSDS sheets on all products of the Work including primary roofing materials as well as primers, adhesives, solvents, cleaning products, etc.
- Submit to the Owner duplicate clean copies of current data sheets and bind in 3-ring, Cerlox or similar folders.
  - Maintain additional MSDS documentation at the site for reference by the work crews.

PRODUCTS

System Description:

.1 4 psf of washed pea stone covering;
.2 Double-pour flood coat of Type III asphalt;
.3 4-ply BUR hot asphalt roofing of 4-ply BUR of high performance Type IV glass felts and Type III asphalt;
.4 1-ply No. 15 perforated felt base membrane mopped with Type III asphalt;

- Use 2-ply BUR if serving as temporary waterproofing.

.5 Cover Board of 1" high density asphalt impregnated, coated both faces, fibreboard in full mopping of Type III asphalt;

.6 2-ply BUR hot asphalt roofing of 4-ply BUR of high performance Type IV glass felts and Type III asphalt;

.7 Tapered insulation;

Fully tapered systems are complex, extremely costly, and raise curbs to considerable heights. In most cases, effective drainage can be achieved by "stepped" tapered layers at much lower cost. References below are illustrative only. Tapered insulation can be adhered with full moppings of hot asphalt, or a low-rise 2-component polyurethane adhesive such as DuoTack 365, or equal from other manufacturer – specify one.

One option for tapered insulation include high density fibreboard, impregnated and coated (including coating of the sawn face). This is the preferred product for thermal and membrane stability but can require longer lead times for delivery. Another option is to use tapered polyisocyanurate with coated glass facers (including the cut face). This product is very "soft", easily damaged during the Work and incurs significant seasonal thermal movements. It is recommended that the fibreboard approach be in the Base Bid and that an Option Price be obtained for the polyisocyanurate approach.

- High Density impregnated and coated fibreboard; or,
- [Polyisocyanurate faced both smooth and cut face with coated glass facers.]
- At Drain Sumps:
    - HD fibreboard, impregnated and coated both faces.

Most older Queen's roofs have roof insulation on the order of R-Imp 15. Many newer construction buildings at Queen's have roof insulation on the order of R-Imp 30. Review OBC requirements, and PPS requirements for the specific circumstances of this building. Keep in mind the height of curbs must be on the order of the insulation thickness plus 1" for accumulated membrane and flashing thickness allowances, plus perhaps 1" for coping slope, and then have 8" of height above the membrane.

.8 Multiple layers of 1½" and 2" polyisocyanurate insulation, with coated glass facers, 4'x4' panels, all joints staggered within and between layers;

The preferred adhesive is hot asphalt moppings as it provides 100% coverage. An industry accepted alternative is to utilize a low-rise 2-component polyurethane adhesive such as Soprema "Duotack 365" (or equal). This should be installed by machine, with ½" to ¾" beads at 12" centres in the field, at 6" centres within 8' of the perimeters, and at 4" centres at the building corners. That approach though risks the adhesive setting (skinning over) before boards are placed and provides maybe 5% to at most 10% coverage for adhesion. One approach is to put the hot asphalt approach in the Base Bid and then seek an Option Price for the use of DuoTack 365 or equal. The success of the low-rise urethane adhesives is highly dependant on environmental and workmanship conditions - and the entire security of the roof system depends on this success.

.9 2-ply No. 15 perforated felt vapour barrier mopped with Type III asphalt;

.10 High performance asphalt primer;

.11 Deck, dry, sloped to drain and free of irregularities.

Materials:

.12 General: The products and components of the roofing system shall be compatible products for use in 4-ply asphalt and high performance glass felt built-up (conventional) roof system.

.13 Primer:

The noted primer is a premium quality product (at a premium price), that has been site tested and proven to provide significantly improved performance to aid in adhering of roofing products. Consultants can approve primers of equal proven performance.

- For BUR: High performance primer for all exposed membrane, gypsum, concrete, wood and metal surfaces.
    - Soprema Elastocol 500.
    - Or approved as equal.

.14 Vapour Retarder (transition membrane) – under curbs, at up-stands, etc.:

- The Contractor can utilize the No.15 perforated felt base ply / vapour barrier for this application but at transitions it shall be at least 2-ply.
- Alternates:
    - 2.5 mm thick modified bitumen, glass mat reinforced, self-adhesive backed and with thermofusible film top face.
    - Approved Products:
        - Soprema "Sopraflash Flam Stick" (self adhesive backed, thermofusible film top face), or other product as approved in writing by the Consultant.
    - Take care to provide winter or summer grade as suitable.
    - Primer:
        - Soprema "Elastocol Stick", or other product as approved in writing by the Consultant.
        - Soprema "Elastocol 500", or other product as approved in writing
        - Products with parting sand (meant to prevent bonding in the roll) are notorious for reduced adhesion of the membrane. In cases where delivery conditions demand alternates in order to maintain progress, products with parting sand on one face could be utilized only after rigorous brooming of the sand and priming.
        - Products with parting compound (sand) will not be accepted in lieu of the above.
        - Failing to flash-off the film will prevent bonding of the membrane with hot asphalt – asphalt is simply not hot enough compared to torch application temperatures.
- Flammable film must be flashed off in the case of the bottom and/or the top face.
- Use this membrane, or approved equal, as required to seal penetrations against seepage of asphalt into the building.

.15 Field Membrane (all roofs):

- In general, avoid Type VI felts as they are not needed for strength and do not lay tight to undulating substrates (i.e., are not adequately flexible for most applications).

- BUR Membrane: Saturated glass fibre reinforced roofing felts, Type IV to CSA A123.17 and ASTM D-2178.
- The noted GAF and Soprema products are premium high-performance products . Critically, they control asphalt flow and are strong enough to tolerate being "tugged" into position without tearing when being rolled out. Other premium products that effectively control asphalt flows, adhesion and tear-strength can be approved. There are big price differences between products so approval should factor in cost.
- Approved products:
    - GAF "GAFGLAS PLY4".
        - Volume purchase terms and lead time for delivery could apply.
        - Soprema "Sopra IV"
        - Or other proven high performance product approved by the Consultant.

.16 Membrane Flashings:

- 4-ply BUR (Stripping) Flashings:
    - Saturated No. 15 organic roofing felts to CSA A123.3M.
        - Approved Product:
            - IKO No. 15 perforated asphalt felt, or approved equal.
- SBS Cover Flashing (atop the 4-ply No. 15 membrane flashings at cant and curb areas) to provide a resilient, rugged, protective cover to the flashings:
  Do not use granulated cap sheet or sanded sheet.
    - Soprema "Sopralene Flam 180" film underface, film top face, 3 mm thickness;
    - Or approved equal product.
- Tie-in and Cover Flashing at Copings, HVAC curbs, etc.:
    - For flashing completely over top of ALL curbs/parapets and at HVAC curbs, up-stands, etc.:
    - Self-adhesive backed membrane, self-sealing at fasteners, with high density cross-laminated polyethylene facing.
    - This membrane seals at fasteners and isolates the metal flashings from the underlying asphalt membranes.
    - "High temperature" grade underlayment membranes are NOT required and were developed for use under low emissivity, high absorption metals in climates like that of Arizona. Approved products below exceed ASTM required 70C for underlayments and can in fact reach 90C and higher. The HT grade products will test to perhaps 140C to 150C – but those requirements are not encountered here in 4-ply roofing applications. It is though not detrimental, other than excessive cost, to use HT grade alternatives. If, however, prolonged (greater than 90 day) direct exposures to the weather/UV is expected, then the HT products might be merited but must be approved in writing by the manufacturer on a case-by-case basis.
    - Approved products:

        - Grace Construction Products "Ice & Water Shield", rubberized asphalt.
        - Soprema "Sopraseal Stick 1100 T" (1.0 mm thick, polyethylene woven reinforcing and SBS modified bitumen) and primer as set out for "Sopraflash Stick" above.
        - Care must be taken to use the winter or summer grade product applicable to the Work conditions.
        - Any proposal for alternates must satisfy a required exposure to UV/weather of at least 90 days as satisfactory to the manufacturer.
    - Temporary curb protection:
        - To be used where wood and curbs (whether insulated or not) must be protected from adverse weather in advance of installing the above-noted "Tie-in and Cover Flashing".
        - Approved Products:
            - Tyvek, Typar or similar wind-secure and watertight sheet.
                - Use "plastic cap nails" for securing temporary curb protection.
                - Standard polyethylene will not be accepted.

.17 Bitumen (all roofs):

- IKO "EasyMelt 200", Type III asphalt, compatible with the membranes in use and the slopes of the Work, to ASTM D312.
- Or approved equal Type III asphalt.

.18 Stone Covering:

- While 5 psf is a common pea stone covering, this leaves considerable loose pea stone and a rate of 4 psf is normally fully satisfactory.
- Washed pea stone.
    - Pea stone should be as dry as possible.
    - Do not use slag.

.19 Precast Concrete Pads (patio slabs – ___ required):

- Modern 24" pavers tend to be dry-cast units fabricated from "mortar" placed in forms, shaken, and then stripped in quick succession. The shaking nullifies any attempt at air entrainment and durability is diminished. The specified product should be a wet-cast cement with a pattern surface for slip resistance, air entrainment and fibre reinforcing,
- 24"x24"x1⅝" (nominal) thick precast (wet-cast) concrete slabs, of uniform thickness, 5% air entrainment, fibre reinforcing, and skid-resistant finish texture.
    - Approved product:
        - Planes Precast Concrete Limited, 1190 McAdoo's Lane, Kingston – lead time could be required.
        - Or approved equal.
        - "Dry pack" products and products of other thickness not permitted.

.20 Cover Board:

Note that fibreboard products coated one face only are meant for mechanical anchorage to a deck, not asphalt adhesion. Coating of both faces is normally crucial to successful adhesion of the roof against blow-off if mechanical fastening is not being specified.

- 1" high density asphalt impregnated, coated both faces, fibreboard.
    - Approved Product:
        - ISOLtop Coated2S, or equal.

.21 Insulation:

- Polyisocyanurate with coated glass facers, 24" x 24" panels.
- Utilize multiple thinner layers in lieu of one or a few thicker layers. This product is prone to significant seasonal dimension variations and movement that can produce ridging of membranes. Terminology can be misleading – do not accept non-coated glass facers (sometimes called "all glass facers") or organic/cellulose facers.
    - Thickness to be ____
- Approved Products:
    - Soprema "Sopra-ISO Plus" with polymer coated glass facers; or,
    - Johns Manville "ENRGY™ 3 CGF", faced both sides with glass fibre reinforced facers, coated; or,
        - Grade 3 – high density of 25 psi
        - Atlas Roofing "ACFOAM-III", faced both sides with glass fibre reinforced facers, coated; or,
        - Equivalent product as approved by the Consultant in writing.
- Roxul or similar semi-rigid batt insulation, thickness to suit for knee walls, curbs, etc.
- Roofmate or equal, 1" thick, for pads under precast concrete pavers (with prefinished steel edge protection also).
- Drains (_____ required):
- Contrary to industry practices, it is ideal that the roofer should supply the drain and direct its installation as they are the most knowledgeable party in most cases as to roof drain products, accessories and required installation practices.
- Thaler Metal Industries RD-4C drains complete with:
    - The Thaler drain noted is time-proven, Ontario-made, and Thaler is a supplier able to execute products with significant customization. The drain should be ordered in copper and the strain dome in cast. Do NOT utilize retrofit (insert) drains unless circumstances require same. If the ferrule is soldered to the drain system on delivery, it is possible it will not fit a site condition where the lateral pipe and elbow is tight to the underside of the deck.
    - vandal-proof cast aluminum dome with hinged access gate clamped directly to drain body;
    - .090" (2.3 mm) pan-formed copper drain body, deck flange and straight copper outlet with ferrule (not soldered in place to facilitate site custom fitting and subsequent soldering);
    - 3/8" (9 mm) bolts soldered to drain;
    - cast aluminum stabilizer ring;
    - underdeck clamping ring and fittings;
    - bituminous painted deck flange.
    - Contractor shall confirm all sizes and site conditions and coordinate with plumber before ordering.

- Alternate Drain:
- The Jay R. Smith drain noted below has also been used with durable success at Queen's. The Consultant needs to identify required components. If flow-control is required, the Consultant needs to establish where same fitting shall be placed (at the deck level, at the top of the collar, etc., depending on the roofing system characteristics).
    - Jay R. Smith Raintrol 1017, CID, U, C, R, HGS, __" size, and associated characteristics.
    - The Sump Receiver ("R") to be used on all metal decks with gypsum sheathing, on wood decks, and on light-weight precast concrete decks.
    - Or approved equal drain products.
- All piping, fittings, adapters, hangars – if/as required.
- All pipe insulation and vapour barrier wrap at interior.

.22 Soil stacks, Exhaust and penetration flashings (_____ required):

- For soil stacks and similar penetrations, provide spun aluminum insulated flanged soil stack type flashings
    - Provide insulated sleeves unless intended for hot pipes and/or unless existing pipes have collars/junctions above the deck.
- Approved product:
    - Thaler SJ-38 (13") or SJ-39 (19") Stack Jack™ Flashing (insulated); or equal to suit site conditions and sizes;

.23 Hot pipe flashings (___ required):

- Provide hot pipe weather collars, separate to the flashings, and vented where applicable.
- Approved product:
    - Thaler MEF-3A hot pipe flashings; 18" aluminum stack; stainless steel weather collar and fittings; mineral wool where permitted; or equal to suit site conditions and sizes.

- Gypsum Sheathing:
    - Applicable only on metal decks. If Type X is required, review membrane also for FR rating.
    - Georgia-Pacific "DensDeck Prime® Roof Board", 1/2" thick.
    - Or approved equal factory primed purpose-made gypsum sheathing for roofing.

Fasteners:

- General:
    - All fasteners to be corrosion resistant.
    - Any fasteners in contact with preservative treated lumber MUST be purpose-made for use with preservative treated lumber.
    - Alternate suppliers for the fastener types listed below will be considered.
- For nailing along top edge of glass field sheet above the cant, 4-ply flashings to curbs, and SBS cover sheet at curbs:
    - Galvanized shingle roofing nails, 10 GA, minimum 1¼" length.
    - Use only HDG for preservative treated substrates.
- For securing wood blocking and cants to concrete and concrete block:

    - Approved screw anchor products:
        - Powers Fasteners (905-673-7295 or 514-631-4216) Type 304 Stainless Steel "Tapper", ¼" x 2¾" or longer to suit.
        - Hilti "KWIK-CON II+ 14-234 THWH Stainless Steel" screws with hex-heads, ¼" shank, 2¾" or longer to suit.
        - Or approved equal.
- For securing plywood to concrete and concrete block:
    - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-½" or longer where required to suit site conditions.
    - Or approved equal.
- For securing wood blocking, cants and plywood to wood substrates:
    - Use hot dipped galvanized nails, stainless steel screws or purpose-made screws for use in preservative treated (ACQ) lumber if applicable, to provide minimum depth of penetration to underlying substrate of 1½".
- For securing perimeter flashings of prefinished metal:
    - Galvanized shingle roofing nails, 10 GA, minimum 1¼" length for in-seam nailing to wood blocking and plywood; minimum 1½".
    - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-¼" or longer where required to suit site conditions where securing into masonry/concrete/stone.
    - ColorMate (or equal) where exposed.
- For securing termination bar:
    - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-½" or longer where required to suit site conditions.
    - Or approved equal.
- For securing blocking and flashing to HSS posts and other steel:
    - Stainless steel TEK screws to suit the site conditions.
- For mechanical attachment of gypsum sheathing to the metal deck:
    - Applicable only on metal decks.
        - FM-approved plates and fasteners for metal deck installation comprised of 3" metal "truss" plates and screw fasteners of length as required penetrating deck a minimum of 1".
        - Approved Products:
    - Metal plates:
        - DekFast "Galvalume Steel Hex Insulation Plate", 2-⅞".
        - Or approved equal.
    - Deck screws (for metal deck):
        - Powers Fasteners "Deck Screws", (#2613) No. 12 x 1½" (min. 1" through deck).
        - Or approved equal for metal deck.
- For securing temporary curb protection:
    - .1 "Plastic Cap Nails" by Ideal, or by H. Paulin, or equal - 2" length.

- The termination bar specified is a superior product with no known equal. Aluminum products made for use with single-ply membranes offer litter rigidity and strength.

.24 Termination bar: Pre-punched with ¼" fastening holes at 1" on centre, of 14 gauge galvanized steel.

- Approved: Sarnafil "Sarnabar", or approved equal.

.25 Wood Blocking, S4S softwood to CSA 0141-M1970.

The first preference is to NOT use preservative treated lumber if same is ACQ treated which tends to attack many fastener types leading to premature failure due to corrosion. Since the roofing is presumed to be watertight, the blocking should be presumed to be able to endure indefinitely without being preservative treated. Specify treated lumber only if needed by project conditions. If specified, include call-out to a cut end treatment product.

- Wood blocking shall NOT be factory preservative treated.
- Sleepers shall include 6x6 timbers as detailed.
  - Utilize preservative treated lumber if the sleepers are floating above the roofing.

.26 Plywood to CSA 0121-M1978 or CSA 0151-M1978;

- Exterior sheathing grade, in dry sound condition.
- Thickness: 16 mm (5/8") except as otherwise shown on the Drawings or specified herein.
  - ½" plywood is required in locations under all curbs where abutting gypsum sheathing.
- Do not use preservative treated plywood.

.27 Cants:

Do NOT specify or allow fibreboard cants unless unusual site conditions demand same – a rare condition. Same are prone to premature damage and premature leakage.

- 4" wood cant to be used throughout.
  - Wood to be either cedar or factory preservative treated.
  - Provide preservative brush-applied treatment for cut ends of factory treated lumber.

.28 Sealants:

- -component polyurethane: Sika 1A, Sika 15LM, or Tremco Dymonic, or approved equal.
- Colour as approved by the Consultant from manufacturer's standard range.

.29 Metal Flashing:

- Prefinished steel, 24 gauge, coating as noted below or approved equal by the Consultant.
  - VicWest "WeatherX";
  - Agway/Andex "Pre-painted Perspectra Series Coated Steel";
  - Or approved equal.
  - Include the manufacturer's 40-year limited warranty (equal to or exceeding that provided with VicWest WeatherX, or Agway/Andex "Pre-painted Perspectra Series Coated Steel", etc.).
- Colour to be from manufacturer's standard colour range to be selected by the Owner upon submissions of actual metal colour samples.
- Cleats to be of same material and gauge.

.30 Miscellaneous Metal:

- 18 gauge galvanized sheet metal for closing nominal sized deck openings (if any).
- 20 gauge galvanized sheet for support of self-adhesive backed membrane as noted on the Drawings for expansion joints and similar connections across structure and between/bridging curbs.
    - Provide protective covers for refrigerant lines – protecting against foot traffic, UV degradation, prolonged wetting and snow cover. Inverted U-shaped with short horizontal legs to be fixed to support blocks, and then 2 sides and top cover, custom fit.
    - Secure same atop suitable sized Dura-Blok Rooftop supports or equal.
- 18 gauge galvanized sheet metal covers to protect insulated refrigerant lines from abuse, piled snow, and UV exposure.
    - Provide sort horizontal legs to be fixed to support blocks, and then 2 sides and top cover, custom fit.

.31 Anti-Slip Walkway Pads (for atop the expansion joints and curbs in locations shown on the Drawings):

- GenFlex "Flexguard Walkway Pad", 30"x30"x5/16".
    - GenFlex Primer.
- Alternatives will be considered; submit sample and cut sheet in advance.

.32 Mastic:

- Tremco Polyroof or approved equal for sealing stack flashings, underside of drain flanges, etc.

.33 Roof Hatch, Rails:

- For roof hatches, one-handed operation is key so that the other hand and 2 feet maintain the Ministry of Labour required 3 points of contact. Include for painting of the hatch exterior. The Bilco product is generally readily available and has a complimentary style of guard. Lexcor makes similar hatches and similar guards. If the Lexcor hatch is chosen, the ease of operation can be improved by reducing the open angle from 90º to perhaps 70º – review and assess or reaching the latch to close the hatch can present a safety issue depending on hatch size. While there is a small corner bar available to aid in climbing in and out, it does not guard the unprotected opening.
- 30"x36" clear opening area, galvanized steel construction, compression spring operator, hold-open arm, one-hand operation, with top and bottom side handles and lockable at the underside – Owner to provide padlock and/or alarms as needed.
    - Approved Product: Bilco Type S-20 roof hatch, or equal.
- An open roof hatch is an "unprotected opening" and deemed a high risk for worked falls and injury. Experience shows that hatches tend to be left open during access for roof service, so guards are essential. Same guards tend to aid in climbing in and out of the open hatch by affording added balance.
- Roof Hatch Rails/Guard to fit the hatch noted above, with self-closing gate and all fittings.
    - Approved Product: Bilco "Bil-Guard 2.0" Hatch Railing System, RL-S, or equal

.34 Duct Supports:

- While normally provided by the mechanical trades on new work, for restoration projects the roofer is the usual party to supply supports.
- Coordinate with mechanical sub-trade for supply and installation of Unistrut assembly complete with junctions, braces, clip angles, etc.
  - Unistrut to be 1⅝", 12 gauge (2.6 mm) galvanized.
- Dura-Blok Rooftop supports of 100% recycled rubber.
  - DBxxxxDS Series is intended and to be sized to suit.
  - Equivalent products are acceptable.

.35 Pipe/Conduit Supports:

- Dura-Blok Rooftop supports of 100% recycled rubber.
  - DBP, 4" high and 10" long or as suited to site conditions.
- Or approved equal.
- Include stainless steel fasteners and suitable straps to secure pipes, conduit, etc.

.36 "Bridges" for safe service access at pipes, cable trays, ducts:
Consultant to provide design showing steps, handrails, etc., maintaining minimum unguarded offset to roof edge of 2.0 m (6'-6") at ends of each GrateWalk or equal.

- Dura-Blok GRATEWALK systems, complete, or equal.

PART 3 - EXECUTION

3.1 General Preparation:

.37 Adherence to the project schedule is essential.

- Coordinate all Work with the Owner.

.38 3.1.2 Provide all required site safety measures needed specific to the Work of this Section.

- Conduct a pre start-up safety meeting with all crew.
- Provide a written statement as to site safety and the fire watch plan; deliver copies to the Owner and Consultant
- Identify the staff member responsible for site safety and provide contact details to the Owner and Consultant.
- If this is a re-roofing project, crew to be made knowledgeable of all issues of concern noted in the project Designated Substance Report.

.39 Conduct a pre-start meeting with the General Contractor to set out access, storage, yard, etc.

.40 Conduct a pre-start meeting with the Owner, Consultant and General Contractor to review scheduling staging of the work of this Section and by other trades and to confirm that he intended roof systems remain the best suited for the conditions at hand.

.41 Examine all preparation Work by others.

- Make review of the site conditions and coordinate with the General Contractor for any needed repairs.
- Do not commence Work until all Work by others fully satisfies the requirements of this Section.

.42 Fire Alarm:

- Coordinate with the Owner to cover and/or disable monitoring of the fire alarm in select areas for brief durations if the Work will risk triggering false alarms.

- The Contractor will be responsible for any false alarms arising from failing to keep doors and intakes closed/covered.
- If a fire watch is required during periods of disabled alarms, Contractor shall be responsible for same.

.43 Hot Work Permit:

- Coordinate with Owner and Consultant as to potential requirement for Hot Work Permit (such as relating to open-flame roofing operations).

Pre-Start Inspection:

.1 New concrete decks must be verified for smoothness and the General Contractor shall have same corrected as needed.

Consultant must make examination and review for potential existence of Siporex or equal lightweight concrete deck panels and develop a plan with the Owner for roofing replacement and safety of workers, occupants and contents. Generally, prepare a plan to relocate occupants for the duration of any work atop such roofs.

.2 Roofer to examine for the unexpected presence of a Siporex, or equivalent, deck as might be located in isolated areas (penthouses, knock-out roof panels for future renovations, etc.).

- Coordinate with the Consultant as to action to be taken to guard against collapse, to protect occupants, to enable adhesion of membrane, to address potential plank replacements with metal deck, etc.

.3 Roofer to verify roof deck dryness by hot asphalt ladle test.

- Consultant to be present to confirm non-frothing results.

.4 Roofer to make a survey for all locations where asphalt seepage to below the deck could occur.

The O.B.C. makes specific references to protecting people (occupants, or workers) from hot asphalt including that which might enter or spill into the building through voids, gaps, cracks and other openings. Asphalt at the source is often from 218ºC to 260ºC (425ºF to 500ºF) and will easily melt though many protective coverings unless carefully assessed. Safety of occupants is paramount.

- Roofer to present a plan for roof-top protection where feasible.
- Owner to coordinate to move/protect furnishings, and to relocate occupants/staff and others from any interior areas under on-going hot asphalt Work until at least past the stage of the vapour barrier installation.

.5 Inspect for and report on damage to existing surfaces, equipment, etc., both at grade and at roof-top in all areas where Work is to be conducted or staged from as relates to existing buildings.

- The Contractor shall duly record, preferably by photographs, all damages as could later be construed to have resulted from the conduct of the Work.
- All reporting must be provided to the Owner and Consultant in advance of conducting any Work.

- Elevator roofs of Siporex panels, core slab, channel slabs and others, with grout between the slabs can cause debris to fall into electronics and mechanisms creating unsafe operations and costly repairs.

.6 Coordinate with the Owner to make review and inspection of elevator roofs for potential debris falling to elevator equipment, cabs, etc.

Set-Up:

.1 All Work must be undertaken with safety railings in place or with fall arrest.

It is legal to work on the roof edge with travel restraint. However, this means that the safety line is taught and in-the-air holding the worker back from slipping over the roof edge – at which moment fall arrest would be essential. Inevitably, significant slack in the safety line will be found to exist and thus working at roof edges with travel restraint is not acceptable in practice.

- Simple travel restraint by carts and ropes, for example, is NOT accepted for Work at the roof edges on this project.
- All safety provisions must also satisfy Ministry of Labour requirements.
- Provide certified life safety fall arrest equipment suited to the roof type and Work conditions of the project for all Work occurring at unprotected roof edges – i.e., roof edges without railings or adequate parapet height.
- Note that a large portion of rooftop safety carts and equipment are NOT certified for use on inverted roofs. Even equipment certified for use on inverted roofs should be reviewed with concern for validity of the certification relative to the work. Inverted roofs can essentially be made into non-inverted roofs by placing the safety equipment on areas with ballast and insulation removed. Finally, note that some equipment certified for non-inverted roofs are also highly suspect and submittals and detailed experienced review by the Consultant is essential.
    - Provide test reports on life safety measures and equipment in advance of introducing equipment to the Work.
- Rescue Plan:
    - As a component of the Site Safety Plan, provide a rescue plan and equipment.
    - Ensure on-site provision for prompt rescue of any worker experiencing an arrested fall.
- NO WORK SHALL COMMENCE WITHOUT ALL SAFETY EQUIPMENT BEING IN PLACE.
- Fall arrest and travel restraint railing safety provisions shall not be removed until such time as Work by this Section and all sub-trades of this Section at the perimeters is completed and same protections are no longer required.

.2 Adhere to all provisions of the Ontario Building Code.

- The trade of this Section shall be knowledgeable of, and strictly follow or exceed the requirements of OBC Section 5.11 Hot Surface Applications.

.3 Provide to the site a kettle of adequate size to suit the Work requirements and to be operated by a trained and experience kettle operator.

- The kettle shall remain at grade, not being placed on roofs.
- The kettle shall not be left unattended at any time while in use and/or hot.

- Maintain secure fencing, minimum 6 foot high, fully around the kettle and all fuel tanks; fencing shall be kept closed.

.4 Provide engineered railings at roof edge(s).

.5 Hoisting or chuting of material to grade and disposal of same shall be coordinated to not encumber the site and the use of the building and grounds.

.6 Provide purpose-made plastic debris chutes as required, or approved hoisting equipment.

.7 Provide clean tarps to protect the building and grounds from damage, staining.

.8 As required, provide plywood coverings to windows and other building components at risk of damage in the course of the Work.

.9 Roofing crews shall have a minimum of two (2) asphalt thermometers (infra-red or submersible probe), in clean and undamaged condition.

- Temperatures must be taken at the kettle and also at the roof.

.10 Roofing crew shall not leave hot asphalt saturated mops lying on the roof at the end of use.

Preparation - Field:

.11 Pre-Start-up Inspection by the Contractor:

General:

- Specify that inspection – cut tests, etc. – take place at all locations where site conditions are unknown and could present cost implications, especially if only exposed once work is in a critical stage.
- In advance of commencing new Work, make examination at any odd locations and/or locations where working conditions are tight or difficult.
    - Prepare a proposed plan for enabling improved access and sound
    - Bring to the attention of the Consultant any and all unexpected, unforeseeable site conditions.
    - Prepare a plan for the scheduling of service interruptions and review same with the Owner in advance of affecting service

Preparation – Mechanical, Plumbing, Electrical, Elevators:

.12 Coordination:

- Consult with the Owner and Consultant in regard to any mechanical, electrical, elevator service interruptions required in order to raise equipment or otherwise take equipment out of service.
    - Once a schedule is set for service interruptions, strictly adhere to same.
- Ensure crew is aware of air intakes and that they coordinate to disable operation of the fans during periods of time when asphalt is being mopped proximate to intakes.
    - .1 Allow to also cover the openings with the fans off in order to prevent passive contamination of air in the ducting.
    - Covered intakes during fan operation risk duct or damper damage and other potentially serious problems.
    - .2 Be certain to coordinate removal of coverings before the Owner reinstates the fans to service.

- Review project Drawings denoting extent of Work required at the mechanical units.

.13 Provide all M&E sub-trade labour and materials to execute the modifications to the HVAC, ducting and other roof-top mounted equipment.

.14 Coordinate with the Owner to terminate any abandoned services.

.15 Drains:

- Make detailed examination of the drains to determine the proper sizes and conditions of the drains to suit the site conditions.
  - Advise the Consultant as to any requirements for interior access and Work.
  - Size drains to the pipe size and not simply to the reduced size of existing retrofit/insert drains if applicable.
- Prepare piping at the building interior to allow for mechanical coupling.

Preparation – Railings:

- Ideally railings will be custom made hot dipped galvanized and set onto Thaler (or equal) post bases and with Thaler (or equal) flanges and large diameter ballast guards. Many of the "stock" railings are certified for use even to the roof edge, but engineering review often casts considerable doubt on the proper rating of these railings for many applications.
- Thaler or equal post bases are subject to engineering review by this Consultant, not the supplier or roofer – some stock bases such as the ARS-115 have been found to need upgrades. The ARS-400 has been found to be satisfactory in most cases.
- Custom spun aluminum "stack flashings" are often required that extend beyond the base plates and Thaler makes these without issue - and it is expected that other suppliers also can fabricate required items.
- Custom ballast collars are required to fit the enlarged circumference of the larger spun aluminum stack flashing. These are needed to prevent the roof ballast from punching a hole through the vulnerable (thin) spun aluminum flashing.
- As an alternative, in some cases where room is limited, or drainage issues exist, smaller stack flashings can be used but tapered plywood is needed all around and over the base plates.

.16 Coordinate for the placement of base plates and anchors to the deck.

Preparation – Gypsum on Metal Deck:

.1 If metal decks apply to the scope of Work, the perimeter curbs (usually 2x4 or 2x6) and cant strips should be fixed onto ½" plywood and not to gypsum board. Ideally the plywood would extend approximately 4" beyond the toe of the cant strip. Similar, but wider, plywood is required at roof curbs. Increase plywood thickness if Type X gypsum is being used.

.2 At the full perimeter of the metal deck, and at roof penetrations/curbs, install a width of ½" thick plywood to support the perimeter curbs including cant strips.

- Utilize plates and screws as per gypsum but using fasteners at 16" o.c. on both edges of the plywood, staggered.

.3 Place 18 gauge metal over any nominal openings found in the deck, or at any irregular transitions of nominal length at the junction of metal deck pans.

.4 Place gypsum sheathing neatly fitted and tightly butted, with long edges parallel to the flutes, and with board edges supported on the flutes

- Stagger the sheets in adjacent rows.
- Confirm current GP Fastener Patterns (or equal supplier) source for reference. Increase fasteners for higher wind exposures, roof edges, building corner, etc.

.5 Secure with FM-approved fasteners and plates, minimum 12 per sheet, set to catch ONLY the top flutes of the deck and using fasteners that will not project a minimum of 1" but not below the level of the bottom flutes.

- Make interior inspection to verify that there is not conduit in the flutes.
- Use additional fasteners and plates at sheet edges in the event of irregularities.
- Use 15 fasteners and plates per sheet for perimeter sheets.
- Utilize the "GP Fastener Patterns" guide supplied by Georgia Pacific for 12 per sheet and 15 per sheet layout.
    - This is found at page 11 of their 20 page brochure "DensDeck Roof Boards".
- Alternatively, if an alternative equal gypsum product has been approved, utilize same manufacturer layout guide.

If acoustic deck is in use, ensure that a joint tape or other product for the gypsum is specified. Confirm the party to supply and install acoustic insulation in the flutes.

.6 For gypsum placed atop perforated acoustical metal decks, provide a proposal to the Consultant as to a method to prevent asphalt seepage – such as by taping the joints or otherwise.

Membrane Installation - General:

.1 Heating of asphalt, equipment and tools, and installation of membrane, to be to applicable CRCA standards except where higher standards are set out in the Contract. Temperatures to be referenced are highly specific to the actual asphalt being used (supplier, and supplier plant) and even more so to the Type of asphalt (i.e., Type II, Type III). EVT addresses the viscosity, measured in centipoise or cps, of the asphalt which varies by temperature. Note that the machine applied approach needs the higher temperature to feed through small holes, but same must be operated slower in order to achieve the same "thickness" of asphalt between plies. Specifying this correctly is key to providing a durable roof.

.2 Asphalt application (all membranes/materials):

- Apply the IKO Easymelt 200 Type III asphalt within 17ºC (30ºF) of EVT.
    - This would be a base of 243ºC (470ºF) for application applied with a mini-mop.
    - For application by hand-mopping, use a reduced application temperature of approximately 224ºC (435ºF).
    - Temperatures noted are those at the moment the asphalt is placed on the roofing felts and not kettle of "lugger" temperature.
    - Roofer to be aware of and avoid approaching the Flash Point of the asphalt in use – 274ºC (525ºF) for EasyMelt 200.

- For alternate Type III asphalt suppliers, obtain and follow the supplier's specific asphalt temperatures which will vary from the above.
  If DensDeck gypsum is in use, review with GP (or equal supplier) as to current maximum asphalt temperature permitted and specify same.

.3 Ensure all surfaces are clean, sound and free of any loose material before proceeding.

.4 Ensure all substrates are dry before proceeding.

.5 Prime ALL substrates (all surfaces without exception and including all curb faces, all existing membranes to be lapped, etc.).

- Use only the specified primer.

Preparation – Curbs, Perimeters, Sleepers, HSS Supports, Raised Roof Penetration Boxes, Skylights, Etc.:

.1 Vapour Retarder at Transitions, under curbs, etc.:

- Execute work with procedures to ensure that vapour barrier transitions extend up behind walls in advance of installing wall cladding systems, and down perimeter walls, lapping over wall vapour barriers.
- Prime substrate and then extend vapour retarder membrane under and behind the woodwork of curbs/sleepers/etc. and projecting beyond same no less than 4" and otherwise as shown on the Drawings.
  - Tie-in V.B. to the perimeter walls in the most direct manner (shortest route) possible.
    - Extend membrane beneath under curbs, retaining the V.B. as close as possible to the building interior, and do not carry V.B. up and over curbs.
- For all self-adhesive backed membrane products, pressure roll with a manufacturer recommended roller (not a paint roller) in all case, full coverage, not just seams.

.1 Blocking:

- In the design of perimeter curbs, utilize time-tested and proven constructions. Avoid "innovative" cantilevers. Ensure that the curb design includes a vapour barrier at the deck level, beneath the curb, not extending up and over the curb. Ensure that the curb is insulated. Avoid HSS steel posts and/or heavy steel Z-shapes that create significant thermal bridging.
- Note that if repairs and maintenance to walls and windows require the use of swing stages, ensure that a plan is prepared to properly support same equipment relative to the curb design.
- Do not construct curbs until transition vapour barrier is installed behind and beneath same where shown on the Drawings and as noted above.
- Do not utilize floating curbs of wood sleepers atop the roof. Build same into the roofing, anchored to the deck.
- Construct curbs generally as shown on the Drawings – to be modified only after review and approval by the Consultant if as-built conditions expose alternatives of advantage to the project.
- Curbs, cants, plywood facings must be rigid and secure, neatly cut and fitted without gaps or twisting.
  - Bevel cut plywood and blocking where shown on the Drawings.

- Secure cants to both the vertical curb and deck, 32" o.c. each edge, staggered.
- Cants must be installed tight to both substrates, free of gaps, voids and twists, and must be neatly fitted.

- Tops of parapets and copings shall be sloped in accordance with conditions shown on the Drawings.

.2 Roof Hatches – Installation:

- The blocking should raise the base flange of the hatch to no less than the height of the roof surface so that a user's feet standing on the top rung are higher than the roof surface.
  - Provide stacked wood blocking atop transition vapour barrier to raise the base flange of the roof hatches to no less than the level of the top of the completed roofing.
  - Verify that roof hatch curbs are level, free of high of low corners that will cause the proper operation of the hatch to be compromised.
  - Set roof hatches atop curbs with stainless steel fasteners at maximum 8" centres.
  - Install ½" plywood to the face of the roof hatch in lieu of any fibreboard (loose) that could be provided with the hatch.
  - Install a wood cant atop the hatch flange and onto the face of the plywood or otherwise as detailed.
- Immediately upon setting woodwork in place, roof-in all woodwork.
  - If necessary, provide full curb protection with weatherproof covers and fully protection also for all insulation in the curbs.
  - Simple polyethylene covers will NOT be accepted.
  - Do not use a polyethylene faced self-adhesive backed material if same product is adhered since it will prevent bonding of roofing set with hot asphalt.

.3 HSS Post Bases:

- Revise text to suit specific conditions at major mechanical supports, stair supports, railings, etc.
- Construct tapered blocking and sloped plywood bases to the HSS posts as shown on the Drawings.
- Ensure that all components are rigidly anchored and that all mitres are neatly fitted and tight.

Installation – General Notes:

.1 Do not commence installation of new roofing until receipt of approval by the Consultant of all preparation work.
.2 Ensure all locations subject to asphalt penetration are sealed or taped.
.3 Ensure Owner has made ready all interior protections, relocations to guard against damage or injury due to unpredicted asphalt intrusions if applicable.

Vapour Barrier:

.1 Extend vapour barrier over full deck, lapping fully and sealing to all transition vapour barrier.
.2 If vapour barrier is left as temporary waterproofing, same must be 2-ply BUR.
.3 If the vapour barrier is left exposed to weather over-night or longer, it must be fully glaze coated to the satisfaction of the Consultant.

Insulation:

.1 Use only undamaged dry product free of cupping, deformation, broken corners, etc.
.2 Neatly fit at perimeters; maintain tight fit at junctions.
.3 Stagger joints 25% to 50% within each layer, and between layers.
.4 Set insulation in 25 pounds/SQ mopping of hot asphalt providing full coverage.
- Do not spread asphalt ahead unduly of the insulation placement
- Utilize weights, equipment and heavy roller application to ensure insulation is fully bonded.
- Score top face of the insulation as required to correct for substrate undulations.

.5 Set tapered insulation atop the top layer of uniform thickness insulation in the same manner set out above.
.6 The above specification is preferred as it provides 100% coverage/adhesion. It should be included in the Base Bid. If an adhesive is under consideration, it should be carefully considered as it provides only 5% to 10% coverage and all too often "in the real world" skins over at least partly before insulation is placed atop it, and/or the insulation frequently sits on high points and does not fully contact the beads of adhesive. This approach could be covered as an Option Price in the form of bid.
.7 [For adhesive application:
- Apply polyisocyanurate with Soprema DuoTack 365 and by use of Soprema applicator machine.
- If an alternative low-rise 2-component adhesive has been approved as part of an alternate manufacturer's system, utilize their specified adhesive and their machine applicator.
- Beads shall be ½" to ¾" at 12" centres in the field; at 6" centres within 8' of the perimeters; and at 4" centres at the building corners.
- Adhesive must be of a grade suited to the temperature conditions at the time of application.
- Insulation must be placed immediately into freshly placed adhesive before same skins or develops the final expanded ribbon.]

Cleavage Layer:

.1 Apply 2-ply high performance Type IV Glass and Type III asphalt BUR atop the insulation, beneath the cover board, to serve as additional protection against the spread of leaks, and to serve as a cleavage plane serving to potentially preserve the costly polyisocyanurate insulation for reuse.
.2 Each ply to be mopped in at 25 pounds/SQ mopping of Type III hot asphalt providing full coverage.

Cover Board:

.1 Install a layer of 1" high density impregnated fibreboard, coated both faces.

.2 Ensure neat cuts and fit.
.3 Set in full coverage of 25 pounds/SQ mopping of Type III asphalt.
.4 Use weights, equipment and/or heavy roller to ensure tight fit of panels to the insulation below.
- Score top face as needed to aid in fitting to undulations of the insulation face.

Tapered Insulation at Drains:

.1 Create the sumps with the tapers shown on the Drawings and neatly fit to the cover board.
.2 Mop in at 25 pounds/SQ mopping of Type III asphalt providing full coverage.
.3 Drain Preparation:
- Ensure that the sumped areas have been prepared at drains.
- Ensure wood blocking set to the deck fully supports the drain flanges in a sumped position relative to the completed roofing.
- Drain flanges shall be primed both faces.

.4 Stack Flashing Preparation:
- Bring to the attention of the Owner/Consultant any stack pipes found to be loose or broken or not extending high enough above the roof.
- Wire brush or abrade any scale/rust and or bitumen or caulking to the exterior of the pipe as may affect a proper fit of the stack flashing.
- Base flanges shall be primed both faces.

Field Membrane:

.1 Base Ply Membrane:
- Over the entire roof surface, apply 1 ply #15 perforated felt base membrane and BUR.
  - Type III asphalt shall be to no less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet per ply.
- At perimeters, ensure that the Base Ply membrane laps onto the top of specified transition vapour barrier membranes.
- Ensure that the Base Ply membrane fits tight to all upturns.
  - Voids or gaps will not be accepted and shall be cut out and repaired before proceeding.
  - If voids are left and covered with further membrane work, the Contractor shall be required to cut out such additional membrane to effect the repairs.
- If this base ply membrane is to be used as short-term waterproofing, not immediately followed by the 4-ply roofing, then it must be increased to 2-ply BUR and glaze coated within the Contract Price.

  In conventional roofing, the vapour barrier and roof membrane must be sealed together at roof perimeters, roof penetrations, etc., in order to create a sealed envelope around the insulation.

.2 4-ply Glass Field Membrane:

- Apply 4 plies of glass reinforced felts and asphalt (to not less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet per ply).
- Glass felts to carry up above the cants extending 2" to 4".
- Within approximately 10-15 minutes (5 minutes in cold weather) of laying the glass, come back and press the membrane firmly to the contour of the cant to remove all voids behind the membrane.
    - This is an ESSENTIAL requirement of the Work.
    - No voids will be accepted in the membrane at the perimeter.
- After ensuring tight fit of membrane to perimeter curbs, nail top of glass felts at 8" o.c. with galvanized shingle roofing nails.
- Do not walk or traffic or use equipment on freshly completed 4-ply glass field membrane.
    - Set out Work process to ensure against operations over freshly placed membrane.

.3 4-ply BUR Flashings at Perimeters, Curbs:

- Apply 4 plies of #15 felts and asphalt (to not less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet).
- Felts to carry from 8" beyond the toe of the cant and then up the curbs a minimum of 16" (all 4 plies) and with no less than 2 plies carrying over the tops and turning down 2" on the exterior face of the copings.
- Within approximately 10-15 minutes (5 minutes in cold weather) of laying the 4-ply felt flashings, come back and press the membrane firmly to the contour of the cant and curbs to remove all voids behind the membrane.
    - This is an ESSENTIAL requirement of the Work.
    - No voids will be accepted in the membrane at the perimeter.
- After ensuring tight fit of membrane to the curbs, nail top of #15 felt flashings at 8" o.c. with galvanized shingle roofing nails.

.4 SBS Cover Sheet:

- The SBS sheet is commonly referred to as a "base sheet" in 2-ply modified bitumen (SBS) roofing. Here it is being used not as a base sheet and not as a cap sheet but rather as a protective cover sheet.
- Complete the perimeters by installing the SBS base sheet (supplied with torchable film at both faces) as a "cover" sheet.
- In advance of placement, flame-off the thermofusible film surface (BOTH faces) and then bed in a full mopping of hot asphalt.
    - Flame must be used where isolated from any wood or flammable materials, overhanging wall cladding, doors, windows, duct openings, etc., and in conformance with current provisions of the O.B.C. and accepted standards of good practice in SBS roofing.
    - Ensure fire protection equipment is at hand.
    - Ensure that a Hot Work Permit has been obtained in advance from the Owner and that the fire detection equipment has been isolated as merited.
- SBS cover shall extend from a minimum of 10" on the roof surface and carry up a height of no less than 12" on walls as measured above the top of the cant, or as detailed on the Drawings.

    - Where possible, avoid carrying the SBS sheet over onto the top of the perimeter curbs as it can impact the fit of sheet metal, especially at corners.
- As in the case of the glass and #15 felts, press the SBS cover sheet tight to all contours to ensure against any voids.
- Nail the top edge of the SBS sheet at 8" centres using galvanized large head shingle roofing nails.
- Ensure that there is no residual thermofusible film in place that would limit the bond of the flood coat asphalt.
- Seal the top edge of the SBS sheet unless covered with the "Tie-in and Cover Flashing" over the tops of the curbs the same day.
    - Failure to do so will probably result in water behind the cover sheet and in such cases all affected sheet must be cut-out and replaced.

Drains, Soil Stacks, etc.:

.1 Seat drains and stack flashings in full back-bedding of mastic.

.2 Set the drains to ensure full and complete support of the flanges and then secure the drain flanges to the deck.
- In most cases, securing of the drain will be by underdeck clamping rings.

.3 Apply 4 plies of #15 felts and asphalt (to not less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet).

.4 Felts to carry minimum 16" beyond the flange.

.5 Press the membrane firmly to the contour of the flanges of stacks and drains to remove all voids behind the membrane.
- This is an ESSENTIAL requirement of the Work.
- No voids will be accepted in the membrane.

Flood Coat:

.1 3.18.1 Before applying flood coat, ensure that all 4-ply roofing (field and flashing) and SBS cover sheet is free of blisters, ridges, lifted edges, etc.
- Ensure also that all thermofusible film on the SBS cover sheet at curbs has been flashed off.
- Block drains to prevent asphalt flow down drains
    - Upon completion of each flood coat, immediately remove blocks to prevent the risk of flooding.
- Ensure that openings/penetrations subject to potential asphalt incursion to the building have been sealed.

.2 Apply a flood coating of asphalt in two separate stages to the entire roof surface at a combined rate of no less than 65 lbs. per 100 square feet and no more than 80 lbs. per 100 square feet.

.3 The double-pour will be executed on 2 different days.

.4 Upon completion, edge laps of the 4-ply roofing shall be minimally apparent.

Tie-in and Cover Flashing Membrane (at copings, curbs):

.1 Prime all contact surfaces, avoiding staining of exposed surfaces, and apply self-adhesive backed "Tie-in and Cover Flashing" membrane across the top of curbs and copings, etc., as shown on the Drawings.

.2 Tie-in and Cover Flashing membrane turns down the inside face of the curbs by a minimum of 4".
.3 Tie-in and Cover Flashing membrane turns down outside face of the curb no less than 2".
- Refer to the Drawings for lapping further onto starter metal detailing if applicable.

.4 In all cases, use manufacturer recommended roller (not a paint roller) to pressure roll the membrane seams and full surface.
.1 Raise expansion joints minimum 4" above the top of the ballast.
.2 Maintain the specified movement gap.
.3 Do NOT utilize the commonly seen detail of a down-turned membrane "U" in expansion joints. The "U" shape collects water but cannot be sealed – there is no practical way to lap and seal membranes in the tight U profile. Instead, use flexible metal to span the joint with an upturn on one side. With movement, the apex of the angle simply flexes to allow movement. The metal allows the self-adhesive backed membrane to be installed and pressure rolled to effectively adhere and seal the seams.
.4 Plan the profile to match one of the proven SMACNA metal expansion joint details for the prefinished steel finish flashings.
.5 Carry light gauge (e.g. 26 ga.) galvanized metal across expansion joints, secured such that it will flex if the joint opens/closes.
- This shall include at deck level for continuity of the vapour barrier, and over the top of the joint to provide watertightness.

.6 Carry the Tie-in and Cover membrane across the metal atop both layers of the light gauge metal.
.7 Pressure roll the membrane.
.8 Fill the gap with Roxul or equal semi-rigid batt insulation.

Drains:
.1 With the membrane work completed, set the clamping ring in place and tightly seat and secure it.
.2 Co-ordinate to have all drain connections made.
.3 Fix cast strainer dome in place.
.4 The next item would be the work of the roofer and sub-trade for restoration roofing.
.5 At the building interior, install new insulation and new vapour barrier wrap, complete and sealed.

Patio Slabs:
.1 Place patio slabs to the layout as noted herein and as shown on the Drawings.
- Unless additional are shown on the Drawings, include no less than 2 slabs at tops and bottoms of ladders/stairs. include at least 4 slabs at roof hatches and doorways.

.2 Maintain 2" gaps between slabs for areas where walkways interrupt primary drainage paths.
.3 Neatly saw-cut slabs to clear mechanical and other equipment and curbs.
- Keep full and cut slabs ½" to 1" offset from curbs and equipment.
  - In no case shall slabs interfere with equipment or roofing flashings.

.4 Mitre cut slabs sitting on uneven bearing and subject to rocking.

.5 The 1" Roofmate or equal pads are essential to protect the membrane. The prefinished metal edge covers protect the Roofmate edges from premature deterioration due to UV exposure.
- Set all slabs atop 24"x24" Roofmate or equal pads with custom prefinished steel flashings extending minimum 6" under the slab (all 4 edges) and ¾" downturned hemmed edges.

Metal Flashing:

.1 New metal flashings to all areas of curbs and parapets at the perimeters and at all roof penetrations, and at all sleepers, shall be as shown on the Drawings and otherwise as reviewed with the Consultant.
.2 Verify that all curbs have proper/intended slope-to-drain.
.3 Contractor shall review with the Consultant all metal details and profiles before commencing fabrication.
- On site review and sketches or mock-ups shall be provided.

.4 Ensure that all metal flashings are placed over an underlayment of the "Tie-in and Cover Flashing" and as generally shown on the Drawings.
- Metal shall not be set onto exposed asphalt and felts.

.5 Continuous cleats shall be used and shall be of the same metal and gauge as the overlaying flashings.
- Cleats shall be installed to level, straight lines and shall be shimmed as required to achieve same results.
- Proper anchorage of the cleats is key to the successful wind-tight installation of the metal flashings.

.6 All joints shall be professionally executed lock joints with fasteners set through hidden tabs.
.7 Allowance shall be made for expansion/contraction.
.8 At expansion joints, utilize a SMACNA approved detail if there is not a detail shown on the Drawings.
- Same detail would be subject to submittal of a drawing/sketch or mock-up at a preliminary stage.

.9 All edges shall be hemmed.
.10 Standing seams should be used at mitred corners.
.11 Turn up ends of the metal flashings at walls.
- Extend minimum 4" up behind siding.
- Turn up and terminate in a reglet, and seal, for termination at masonry.

.12 Exposed fasteners shall be limited to those essential by the nature of the Work and/or where indicated on the Drawings.
- Include colour-mate screws at the inner coping edge for added wind restraint.

.13 Maintain separation of dissimilar metals by using separation sheet or by back-coating.
.14 Sealants are not to be used on metal flashing joints, apart from where indicated on the Drawings and as approved by the Consultant at the request of the Contractor.
.15 Anti-slip Protection:
- At wide curbs and/or expansion joints in walkways where foot traffic is reasonably expected, and as shown on the Drawings, neatly cut, test-fit, prime and pressure roll into place the self-adhesive backed anti-slip protection matts.

Sundry Mechanical Work:

.1 Complete sheet metal covers for all refrigerant set lines using also the specified pipe support blocks.
.2 Supply and install all needed pipe, conduit and duct supports.
.3 Install any specified/designed "bridges" with steps and railings to enable safe service access over cable trays, pipes, ducts, etc.

Roof Hatches – Completion:

.1 Install pre-fabricated guards matched to the hatch frame using only stainless steel fasteners.
.2 Verify proper operation of the guard gates.
.3 Specify painting here or in a Painting Section. Exterior colour below is from 2016-18 standard but should be confirmed by the Consultant.
.4 Complete painting of the exterior of the hatch cover, and of the inner faces of the hatch sides.
- Exterior of the pre-primed hatch to be 2 coats to Owner approved standard.
- Remove stickers/labels, dirt and asphalt.
  - Benjamin Moore "Super Spec HP® D.T.M. Alkyd Semi-Gloss Enamel KP24"
  - Colour: RAL 7024 Graphite Grey (Semi-Gloss)
- Inner faces of the hatch opening to be two coats of white.
  - Benjamin Moore "Ultra Spec® 500 Interior Latex Primer" (K534) or "Fresh Start® Multi-Purpose Latex Primer" (F023)
  - Finish: Benjamin Moore "Ultra Spec 500", white.

Completion, Clean-up:

.1 Ensure that all temporarily removed/lifted equipment is put back in place with new stainless steel anchors to suit site conditions and left sealed and watertight.
.2 Ensure that all HVAC and other equipment have been put back in service and that all electrical work and service connection is complete.
.3 Verify that all drain fittings are installed and secure.
.4 If/as applicable, verify that all drain piping is properly installed, watertight and insulated and wrapped.
.5 All debris and removed equipment is to be removed and disposed of offsite.
.6 All surfaces are to be cleaned, fully, of bitumen and other stains resulting from the work.
.7 All drains are to be verified to be free flowing and unobstructed, complete.
.8 At grade, all remnants of the work shall be cleaned up, including all wind-blown insulation and other debris.
.9 Clear adjacent roofs and other surfaces of any debris from the work.
.10 Repair grade level landscaping by installing sod to any damaged grass areas affected by the Work.

Final Inspection:

.1 Verify that all Work is completed.
.2 Verify that all areas of the Work are clean and that no debris remains on site.
.3 Co-ordinate with the Consultant and Owner to conduct a final inspection.

.4 Provide completed OIRCA/CRCA warranties (roofing and sheet metal, etc.) to the Owner.
.5 Provide metal paint finish warranty to the Owner.
.6 Turn over roof hatch and roof hatch guard manuals to the Owner.

07 51 12 4 Ply BUR Inverted Roof

GENERAL

.1 For new roofs, ensure that all roofs are accessible by roof hatches, operable/lockable windows, stairs or ladders.
.2 For new and existing roofing projects, ensure that there are fixed railings to protect where foot traffic for access and service must approach within 2.0 m (6'-6"') from a roof edge. This Consultant shall engineer the railing system and not pass that task to the Contractor.
.3 For new and existing roofing, ensure that skylights that have sills less than 42" above the roof are provided with guards to prevent falling onto (and through) the skylights – or equal protection.
.4 If premanufactured guards are proposed to be used, the engineering and design of same must be reviewed by the Consultant to confirm that the supplier data is accepted as sound for the purposes at hand.
.5 If the only solution feasible for protection is the use of fall arrest equipment, such as a fixed life line and anchors, this Consultant shall fully design and engineer same system. Where possible, utilize anchors set to walls in lieu of anchors set to the roofing.
.6 Ensure that all conduit trays, piping and ducting in the completed roofing that must be crossed by service personal are provided with safe steps/bridges and other means of passage. In some cases, where elevators and/or gas-fired equipment must be serviced, TSSA requirements should be considered. Improved lighting could be required to ensure safe trafficking of a roof at night for emergency service.

Description of the Work:

.1 Basic Scope:
Identify the roofs by alpha and/or numeric references. Include gross area of each roof denoting if the measure if to the inside (preferred) or outside of the curbs. Include reference to perimeter lengths to aid bidders in assessing curb flashings. Identify if measurements are from site measurement, or record drawing measurements.

- The roofs of this Section are designated as _____.

The line below pertains not to the common "Related Sections" sentence but rather to information to be highlighted to bidders as to special coordination requirements. This could include special lifting of mechanical equipment, potential shut-downs needed due to exhaust fumes, known special events, etc.

.2 Coordinate with ____
.3 All other requirements of the Work are as specified and/or as noted on the Drawings.

Qualifications:

.1 PPS/Queen's have a strict requirement for roofers as either prime or sub-contract contractors to comply with the following.
.2 The roofer shall be a member in good standing in the OIRCA and/or the CRCA.
.3 All workers for this Section shall be employees of the roofer and not sub-contractors, independent contractors, or otherwise.
.4 The full-time working foreman and lead-hand of the roofing crew shall have no less than 10 years verifiable experience in 4-ply built-up asphalt roofing.
.5 Sheet metal workers shall have no less than 5 years verifiable experience in the fabrication and installation of roofing sheet metal and shall be fully knowledgeable of the standards set out in the SMACNA manual.
.6 The roofer must specifically carry open-flame insurance as part of their roofing insurance coverage.

Warranty:

.1 The roofing contractor associations limit warranties to 2 years. Longer warranties, such as 15-year or 20-year, can be available for some roof types through the manufacturer – the manufacturer will often in turn secure the contractor's warranty to them. Same warranties generally require that only products from the main product manufacturer can be used whereas PPS/Queen's would seek to incorporate some alternative products where experience shows improved performance is available. PPS/Queen's have been getting reliable and low-maintenance 30-year to 40-year performance out of 4-ply asphalt built-up roofing systems, so the length of the warranty is less a concern than the quality of the work.
.2 The Contractor shall warrant all labour and workmanship, complete, so as to ensure the soundness and continued watertightness of the completed Work for a period of two (2) years.
.3 The roofing warranty document shall be the standard OIRCA or CRCA warranty duly executed by the member roofer and provided to the Owner.
.4 Warranty requirements include also the proper performance of the prepainted metal as follows.
- This shall include the manufacturer's 40-year limited warranty (equal to or exceeding that provided with VicWest WeatherX, or Agway/Andex "Pre-painted Perspectra Series Coated Steel").
- This shall include for 2 years for the complete wind-tight security of the metal flashings.
- For larger projects, cross reference the related Sections. This could be for Metal Flashings and Trim, other Roofing Sections, etc.

.5 For additional requirements and clarifications, refer to:
- 1.3.4.1 Section _____.

Reference Standards:

The following 2 sub-sentences are the most important as the referenced documents are inclusive.

.1 Except where explicit directions are given in the Contract documents, do all roofing work in accordance with applicable CRCA and NRCA standards as set forth in the CRCA Roofing Specifications Manual and applicable NRCA manuals.

.2 Except where explicit directions are given in the Contract documents, do all sheet metal work in accordance with applicable SMACNA and/or CDA standards.

Delete all inapplicable sub-sentences within 1.4.3 through 1.4.10 – which is expected to be most of the sub-sentences.

.3 ASTM International Inc.

- ASTM C726-[05], Standard Specification for Mineral Fiber Roof Insulation Board.
- ASTM C728-[05], Standard Specification for Perlite Thermal Insulation Board.
- ASTM C1002-[07], Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- ASTM C1177/C1177M-[06], Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- ASTM C1396/C1396M-[06a], Standard Specification for Gypsum Board.
- ASTM D41-[05], Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- ASTM D226-[06], Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- ASTM D312-[00(2006)], Standard Specification for Asphalt Used in Roofing.
- ASTM D448-[03a], Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- ASTM D450-[07], Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.
- ASTM D1863-[05], Standard Specification for Mineral Aggregate Used on Built-Up Roofs.
- ASTM D2178-[04], Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
- ASTM D4601-[04], Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
- ASTM D6380-[03], Standard Specification for Asphalt Roll Roofing (Organic Felt).

.4 Canadian General Standards Board (CGSB)

- CGSB 37-GP-9Ma-[83], Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.5 Canada Green Building Council (CaGBC)

- LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).

- LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

1.4.6 Canadian Standards Association (CSA International)

- CSA A123.2-[03], Asphalt-Coated Roofing Sheets.
- CSA A123.3-[05], Asphalt Saturated Organic Roofing Felt.
- CSA A123.4-[04], Asphalt for Constructing Built-Up Roof Coverings Waterproofing Systems.
- CSA A123.16-[04], Asphalt-Coated Glass Base Sheet.
- CSA A123.17-[05], Asphalt Glass Felt Used for Roofing and Waterproofing.
- CSA A123.21-[04], Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- CSA A231.1-[06], Precast Concrete Paving Slabs.
- CAN/CSA-ISO 9001-[00], Quality Management Systems - Requirements.
- CAN/CSA-ISO 14001-[04], Environmental Management Systems - Requirements with Guidance for Use.
- CSA O121-[08], Douglas Fir Plywood.
- CSA O151-[04], Canadian Softwood Plywood.

.6 Canadian Roofing Contractors' Association (CRCA)

- CRCA Roofing Specifications Manual - [1997].

.7 Factory Mutual (FM Global)

Reference to FM approvals requires that the Consultant have comprehensive knowledge of same standards and how specified materials/assemblies must exactly match tested assemblies – which are not likely to be those in use on many PPS/Queen's projects. This is not something for the Contractor to have any role in as to levels, components, assemblies, etc. DELETE 1.4.8 if it is not to be used.

- FM Approvals - Roofing Products.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- Material Safety Data Sheets (MSDS).

.9 Underwriters' Laboratories of Canada (ULC)

- CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- CAN/ULC-S702.2-[03], Standard for Mineral Fibre Thermal Insulation for Buildings.
- CAN/ULC-S704-[03], Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- CAN/ULC-S706-[02], Standard for Wood Fibre Thermal Insulation for Buildings.

Environmental Requirements:

.1 Conduct Work only during dry weather conditions and as set forth to be satisfactory herein and to the membrane and roofing materials suppliers.

.2 Ensure that all materials introduced to the roofing system are dry, clean and undamaged.

Delivery, Storage and Handling:

.1 All products delivered to the site shall be as set out in the Specifications or otherwise as explicitly approved in writing by the Consultant in advance of delivery to the site.
.2 All products shall be stored with labels in place.
- Weigh bills shall be provided upon delivery of products that inherently do not have labels (such as ballast, etc.).

.3 Roof insulation must be protected and stored secure from wind blow off and undue weathering, wetting of edges, warping, edge damage, etc.
.4 Membrane rolls should be stored on end with adequate supports.
- Membrane rolls must be maintained above any moisture that could impact the rolls including rain, snow and splash.

.5 Store adhesives and caulking in sealed, labeled containers and at temperatures above +5C.
- Do not store flammable products in Queen's buildings, penthouses, etc.

.6 All board goods (insulation, fibreboard, gypsum sheathing, plywood, etc.) and all lumber products must be tarped with breathable water repellant covers and kept on raised sleepers during storage.
- Do not store under polyethylene or other non-breathable covers that will subject covered products to wetting from condensation.

Protection:
.1 Seal the perimeters of the membrane at the end of each working day to prevent water infiltration into the roof system and/or building.
.2 At no time are perimeter wood curbs, or other woodwork, be left exposed to direct or indirect weathering.
- All woodwork MUST be protected with roofing materials, not polyethylene, the same day that the woodwork is installed.

.3 Adequate care shall be taken by all trades to protect the installed membrane from damage.
- Care MUST be taken to not traffic across fresh BUR.

.4 Protect the building interior and adjacent exterior surfaces from damage, asphalt, staining.

Submittals:
.1 Products:
- Submit product data sheets only if being alternatives approved from those listed herein.
- If high density tapered (or uniform thickness) fibreboard is to be used in the Work, include product data sheets in advance to ordering product.

.2 Schedule:
- Provide a detailed update of the roofing portion of the project schedule as submitted with the project tender.
  - Include reference to crew size, working foreman, lead-hand, etc.
  - Make clear indication as to when and where mechanical and electrical equipment will need to be out of service in a manner satisfactory to the Owner's operations.

- Make clear indication as to when and where sheet metal work will commence with clear indications as to working periods required to reach completion.
- Site clean-up and staging will be reviewed and coordinated to minimize impact.
- Identify all areas of coordination with other trades and with the Owners and make note of all potential interruptions of service, shut-downs.

- Provide a proposed breakdown of components of the Work for progress billing purposes.
  - Include: (Edit to suit job requirements.)
    - Bonds, insurance, Permit(s);
    - Mobilization, site protection, site access, crane, light standards relocated, temporary security lighting, walk-through scaffold to all entry and exit locations;
    - Hazardous materials abatement, disposal;
    - Roof demolition, tear-off, disposal, recycling;
    - Vapour barrier (transitions), carpentry, curb insulation;
    - Raising of door thresholds where existing are low;
    - Raising of skylights (curbs) where existing are low;
    - Life safety anchors, railing bases, roof hatches;
    - Duct removal and preparation;
    - Roof membrane installation, drains, mechanical and electrical;
    - Roof insulation and ballasting, pavers;
    - Sheet metal flashings;
    - Completion of railings;
    - Penthouse cladding;
    - Final cleaning, as-built drawing preparation and submittals, O&M manual submittals;
    - Demobilization, site restoration including hard and soft landscape, etc.

.3 Samples:

- Metal Colour(s):
- .1 Upon commencing the project, submit one (1) actual sample of each colour of sheet metal required to be used in the Work.
  - Samples shall be minimum 1½" x 3".
  - Provide confirmation of the paint/coating grade and the gauge of the base metal to be supplied.
    - Include supplier name.
    - Include sample 40-year warranty.

.4 Shop Drawings, Sketches, and/or Mock-ups:

- For sheet metal Work, shop drawings or sketches should be provided upon commencing roofing Work.
- If upon review with the Contractor the Consultant provides written acceptance that mock-ups can be provided in lieu of drawings/sketches, then same shall be prepared, revised as needed, and accepted by the Consultant before sheet metal fabrication commences.

- If a mock-up is being done to show assembly of components, but the colour and/or base metal thickness/type does not exactly match the specifications, then Consultant approval, if given, is limited solely to the general assembly and not to metal, thickness, coating product, colour, etc.

.5 Products:

- Submit full listing of products to be provided.
  - Where same match the specifications, include only in list format, do not include Product Data sheets at this stage.
  - Include the listing of fasteners.
- Alternate Products:
  - It is not expected that alternate products will be provided or proposed.
  - The Contractor shall be certain to allow time and resources to secure all specified products for on-time delivery.
  - Confirm below the Division 1 Section number applicable.
  - If circumstances of delivery, or manufacturing problems, etc., arise beyond the control of the Contractor, and not being due to late or inadequate planning, then submittals for Alternates shall be as set out in Section 01 33 00, Submittal Procedures.
  - Submittals must include clean Product Data sheets for specified and proposed alternative products.
  - Submittals must show clear reference to the proposed products matching specified product performance data and characteristics.
  - Submittals must show the cost variance information including supplier invoices upon demand by the Consultant.
  - Upon demand by the Consultant, the Contractor shall provide physical samples of the alternate products being proposed.

.6 MSDS:

- Provide MSDS sheets on all products of the Work including primary roofing materials as well as primers, adhesives, solvents, cleaning products, etc.
- Submit to the Owner duplicate clean copies of current data sheets and bind in 3-ring, Cerlox or similar folders.
  - Maintain additional MSDS documentation at the site for reference by the work crews.

PRODUCTS

Materials:

.1 General: The products and components of the roofing system shall be compatible products for use in 4-ply asphalt and felt built-up protected membrane roof system.

.2 System Description:

- 2.1.2.1 Roof Type RF1:
- Consultant is responsible for confirming that the existing roofing can support the ballast loading plus any additional loadings such as due to the implementation of control flow drains. Ballast is to be designed to be suitable to ensure against wind uplift and is not normally intended to be for anti-buoyancy.

- Consultant to edit ballast load to suite specific conditions. 15 psf of the specified ballast will be approximately 2" in thickness. 22 psf will be as much as 4" in thickness. Ensure that detailed curb heights rise at least 6" above the ballast, preferably more.
    - 15 psf of limestone ballast;
        - Increase to 22 psf at perimeter 6'.
        - Filter fabric;
        - Most older existing Queen's roofs have 2 layers of 2" Roofmate (or equal). Many have a total of 4" comprised of 1" on the bottom, and 3" on the top layer. Most newer buildings have tended to comprise a total thickness of 6". Expanded-extruded polystyrene is subject to significant seasonal thermal expansion, to flotation, and to problems of lapping after flotation; Utilize multiple thinner layers in lieu of thicker layers.
        - 2" thick extruded polystyrene insulation (ASTM C578-01, Type VI): Roofmate, Foamular 404, or equivalent;
        - 2" thick extruded polystyrene insulation (ASTM C578-01, Type VI): Roofmate, Foamular 404, or equivalent;
        - 2" thick extruded polystyrene insulation (ASTM C578-01, Type VI): Roofmate, Foamular 404, or equivalent;
        - 6 mil polyethylene separation sheet;
        - Double-pour flood coat of Type III asphalt to minimum combined weight of 60 pounds/SQ;
        - 4-ply BUR hot asphalt roofing of 4-ply BUR of high performance Type IV glass felts and Type III asphalt;
    - Interply rate each to be 25 pounds/SQ;
        - 1-ply #15 perforated felt base membrane;
    - Interply rate each to be 25 pounds/SQ;
        - High performance asphalt primer;
        - Concrete deck, dry, sloped to drain and free of irregularities.
- Roof Type RF2:
    - 15 psf of approved limestone ballast;
        - Increase to 22 psf at perimeter 6'.
        - Filter fabric;
        - 2" thick extruded polystyrene insulation (ASTM C578-01, Type VI): Roofmate, Foamular 404, or equivalent;
        - 2" thick extruded polystyrene insulation (ASTM C578-01, Type VI): Roofmate, Foamular 404, or equivalent;
        - 2" thick extruded polystyrene insulation (ASTM C578-01, Type VI): Roofmate, Foamular 404, or equivalent;
        - 6 mil polyethylene separation sheet;
        - Double-pour flood coat of Type III asphalt to minimum combined weight of 60 pounds/SQ;
        - 4-ply BUR hot asphalt roofing of 4-ply BUR of high performance Type IV glass felts and Type III asphalt;
    - Interply rate each to be 25 pounds/SQ;
        - 1-ply #15 perforated felt base membrane;

- Interply rate each to be 25 pounds/SQ;
  - High performance asphalt primer;
  - Factory primed gypsum roof deck sheathing, mechanically fastened;
- Abut to ½" plywood at the full perimeter and as shown on the Drawings.

.3 Primer:

- The noted primer is a premium quality product (at a premium price), that has been site tested and proven to provide significantly improved performance to aid in adhering of roofing products. Consultants can approve primers of equal proven performance.
- 2.1.3.1 For BUR: High performance primer for all exposed membrane, gypsum, concrete, wood and metal surfaces.
  - Soprema Elastocol 500.
  - Or approved as equal.

.4 Vapour Barrier (field):

- No.15 perforated felt base ply / vapour barrier BUR with Type III asphalt.
- This must be 2-ply if being retained for short-term waterproofing.
- This must also be glaze-coated if left overnight or longer.

.5 Vapour Retarder (transition membrane – under curbs, at up-stands, etc.):

- The Contractor can utilize No.15 perforated felt base ply / vapour barrier BUR with Type III asphalt for this application but at transitions it shall be at least 2-ply.
- Alternates:
  - 2.5 mm thick modified bitumen, glass mat reinforced, self-adhesive backed and with thermofusible film top face.
    - Approved Products:
      - Soprema "Sopraflash Flam Stick" (self adhesive backed, thermofusible film top face), or other product as approved in writing by the Consultant.
  - Take care to provide winter or summer grade as suitable.
  - Primer:
    - Soprema "Elastocol Stick", or other product as approved in writing by the Consultant.
    - Soprema "Elastocol 500", or other product as approved in writing
    - Products with parting sand (meant to prevent bonding in the roll) are notorious for reduced adhesion of the membrane. In cases where delivery conditions demand alternates in order to maintain progress, products with parting sand on one face could be utilized only after rigorous brooming of the sand and priming.
    - Products with parting compound (sand) will not be accepted in lieu of the above.
- Failing to flash-off the film will prevent bonding of the membrane with hot asphalt – asphalt is simply not hot enough compared to torch application temperatures.
- Flammable film must be flashed off where present on the bottom and/or the top face.

- Use this membrane, or approved equal, as required to seal penetrations against seepage of asphalt into the building.

.6 Field Membrane (all roofs):

In general, avoid Type VI felts as they are not needed for strength and do not lay tight to undulating substrates (i.e., are not adequately flexible for most applications).

- BUR Membrane: Saturated glass fibre reinforced roofing felts, Type IV to CSA A123.17 and ASTM D-2178.
- The noted GAF and Soprema products are premium high-performance products . Critically, they control asphalt flow and are strong enough to tolerate being "tugged" into position without tearing when being rolled out. Other premium products that effectively control asphalt flows, adhesion and tear-strength can be approved. There are big price differences between products so approval should factor in cost.
- Approved products:
  - GAF "GAFGLAS PLY4".
    - Volume purchase terms and lead time for delivery could apply.
    - Soprema "Sopra IV"
    - Or other proven high performance product approved by the Consultant.

.7 Membrane Flashings:

- 4-ply BUR (Stripping) Flashings:
  - Saturated No. 15 organic roofing felts to CSA A123.3M.
    - Approved Product:
      - IKO No. 15 perforated asphalt felt, or approved equal.
- SBS Cover Flashing (atop the 4-ply No. 15 membrane flashings at cant and curb areas) to provide a resilient, rugged, protective cover to the flashings:
- Do not use granulated cap sheet or sanded sheet.
  - Soprema "Sopralene Flam 180" film underface, film top face, 3 mm thickness;
  - Or approved equal product.
- Tie-in and Cover Flashing at Copings, HVAC curbs, etc.:
  - For flashing completely over top of ALL curbs/parapets and at HVAC curbs, up-stands, etc.:
    - Self-adhesive backed membrane, self-sealing at fasteners, with high density cross-laminated polyethylene facing.
      - This membrane seals at fasteners and isolates the metal flashings from the underlying asphalt membranes.
      - "High temperature" grade underlayment membranes are NOT required and were developed for use under low emissivity, high absorption metals in climates like that of Arizona. Approved products below exceed ASTM required 70ºC for underlayments and can in fact reach 90ºC and higher. The HT grade products will test to perhaps 140ºC to 150ºC – but those requirements are not encountered here in 4-ply roofing applications. It is though not detrimental, other than excessive cost, to use HT grade

alternatives. If, however, prolonged (greater than 90 day) direct exposures to the weather/UV is expected, then the HT products might be merited but must be approved in writing by the manufacturer on a case-by-case basis.

- Approved products:
  - Grace Construction Products "Ice & Water Shield", rubberized asphalt.
  - Soprema "Sopraseal Stick 1100 T" (1.0 mm thick, polyethylene woven reinforcing and SBS modified bitumen) and primer as set out for "Sopraflash Stick" above.
    - Care must be taken to use the winter or summer grade product applicable to the Work conditions.
- Any proposal for alternates must satisfy a required exposure to UV/weather of at least 90 days as satisfactory to the manufacturer.

- Temporary curb protection:
  - To be used where wood and curbs (whether insulated or not) must be protected from adverse weather in advance of installing the above-noted "Tie-in and Cover Flashing".
  - Approved Products:
    - Tyvek, Typar or similar wind-secure and watertight sheet.
      - Use "plastic cap nails" for securing temporary curb protection.
      - Standard polyethylene will not be accepted.

.8 Bitumen (all roofs):

- IKO "EasyMelt 200", Type III asphalt, compatible with the membranes in use and the slopes of the Work, to ASTM D312.
- Or approved equal Type III asphalt.

.9 Stone Ballast/Covering:

Important Note: It has been established over several decades that many sources of local limestone ballast have not proven to be durable and tend to deteriorate, turning to dust, despite satisfying numerous product standards. Queen's have previously replaced such deteriorated ballast at considerable cost well in advance of roof replacement being required. To that end, ballast should come only from a pre-approved time-proven source.

- Roofing ballast to be 1¼" limestone, crushed opaque, non-porous material, free from moisture, ice, snow or other detritus, washed.
- Unless from the below noted approved source, a sample must be provided to Consultant for approval prior to delivery to site.

  Based on experience, it is not expected that submitted test reports will be adequate to ensure durability. However, the Consultant can approve alternates.

- Unless from the below noted approved source, ballast shall be tested for petrographic analysis and magnesium sulphate content to establish freeze-thaw stability and subject to approval.
- Approved source:
  - Spratt's Aggregate in Carp, Ontario.
  - Or other source pre-approved.
  - Retain the weigh bill and provided a copy to the Consultant.

.10 Precast Concrete Pads (patio slabs – ___ required):

Modern 24" pavers tend to be dry-cast units fabricated from "mortar" placed in forms, shaken, and then stripped in quick succession. The shaking nullifies any attempt at air entrainment and durability is diminished. The specified product should be a wet-cast cement with a pattern surface for slip resistance, air entrainment and fibre reinforcing,

- 24"x24"x1⅝" (nominal) thick precast (wet-cast) concrete slabs, of uniform thickness, 5% air entrainment, fibre reinforcing, and skid-resistant finish texture.
  - Approved product:
    - Planes Precast Concrete Limited, 1190 McAdoo's Lane, Kingston – lead time could be required.
    - Or approved equal.
    - "Dry pack" products and products of other thickness not permitted.

.11 Filter Fabric:

- Purpose made product of woven polyolefin, UV stabilized and water permeable, with lines to guide in lapping.
- Approved Product: "Henry Filter Fabric N03" or equal.

.12 Insulation:

- Dow "Roofmate" (or equivalent) extruded polystyrene to CGSB 51-GP-20M, Type 4, and ASTM C578-01, Type VI, size 24"x48" (preferred) with shiplap edges; 24"x96" will be accepted if the smaller boards are not available.
- Thickness:
  Adjust below sentence to suit project insulation requirements using multiple thinner layer and avoiding thicker layers.
  - Bottom layer at 1" (butt edges), and top layer at 3" (ship-lapped edges).
- Roxul or equal dense semi rigid batt insulation, thickness to suit for knee walls, curbs, etc.

.13 Separation sheet:

- 6 mil polyethylene.

.14 Drains (_____ required):

Contrary to industry practices, it is ideal that the roofer should supply the drain and direct its installation as they are the most knowledgeable party in most cases as to roof drain products, accessories and required installation practices.

- Thaler Metal Industries RD-4C drains complete with:
  The Thaler drain noted is time-proven, Ontario-made, and Thaler is a supplier able to execute products with significant customization. The drain should be ordered in copper and the strain dome in cast. Do NOT utilize retrofit (insert) drains unless circumstances require same. If the ferrule is soldered to the drain system on delivery, it is possible it will not fit a site condition where the lateral pipe and elbow is tight to the underside of the deck.

- vandal-proof cast aluminum dome with hinged access gate clamped directly to drain body;
- .090" (2.3 mm) pan-formed copper drain body, deck flange and straight copper outlet with ferrule (not soldered in place to facilitate site custom fitting and subsequent soldering);
- 3/8" (9 mm) bolts soldered to drain;
- cast aluminum stabilizer ring;
- underdeck clamping ring and fittings;
- bituminous painted deck flange.
- Contractor shall confirm all sizes and site conditions and coordinate with plumber before ordering.

- Ballast guards:
  Allow the height to match the insulation thickness, plus minimum 2" thickness of ballast at the drain, and the noted 2" clearance.
  - Provide custom-made perforated stainless steel ballast guards of a height no less than 2" extension above the ballast.

.2Approved Product:

- If an alternate product is proposed, care must be taken to review the hole size and spacing of holes or drainage could readily be blocked.
  - Thaler T-12 ballast guard to custom height to achieve a minimum of 2" above the ballast or 4" above the insulation.
  - Or equal product of matching gauge and perforation density.

The Jay R. Smith drain noted below has also been used with durable success at Queen's. The Consultant needs to identify required components. If flow-control is required, the Consultant needs to establish where same fitting shall be placed (at the deck level, at the top of the collar, etc., depending on the roofing system characteristics).

- Alternate Drain
  - Jay R. Smith Raintrol 1017, CID, U, C, R, HGS, __" size, and associated characteristics.
  - The Sump Receiver ("R") to be used on all metal decks with gypsum sheathing, on wood decks, and on light-weight precast concrete decks.
  - Or approved equal drain products.
- All piping, fittings, adapters, hangars – if/as required.
- All pipe insulation and vapour barrier wrap at interior.

.15 Soil stacks, Exhaust and penetration flashings (_____ required):

- For soil stacks and similar penetrations, provide spun aluminum insulated flanged soil stack type flashings
  - Provide insulated sleeves unless intended for hot pipes and/or unless existing pipes have collars/junctions above the deck.
- Approved product:
  - Thaler SJ-38 (13") or SJ-39 (19") Stack Jack™ Flashing (insulated);
  - or equal to suit site conditions and sizes.

.16 Hot pipe flashings (___ required):

- Provide hot pipe weather collars, separate to the flashings, and vented where applicable.

- Approved product:
  - Thaler MEF-3A hot pipe flashings; 18" aluminum stack; stainless steel weather collar and fittings; mineral wool where permitted;
  - or equal to suit site conditions and sizes.

.17 Gypsum Sheathing:

Applicable only on metal decks. If Type X is required, review membrane also for FR rating.

- Georgia-Pacific "DensDeck Prime® Roof Board", 1/2" thick.
- Or approved equal factory primed purpose-made gypsum sheathing for roofing.

.18 Fasteners:

- General:
  - All fasteners to be corrosion resistant.
  - Any fasteners in contact with preservative treated lumber MUST be purpose-made for use with preservative treated lumber.
  - Alternate suppliers for the fastener types listed below will be considered.
- For nailing along top edge of glass field sheet above the cant, 4-ply flashings to curbs, and SBS cover sheet at curbs:
  - Galvanized shingle roofing nails, 10 GA, minimum 1¼" length.
  - Use only HDG for preservative treated substrates.
- For securing wood blocking and cants to concrete and concrete block:
  - Approved screw anchor products:
    - Powers Fasteners (905-673-7295 or 514-631-4216) Type 304 Stainless Steel "Tapper", ¼" x 2¾" or longer to suit.
    - Hilti "KWIK-CON II+ 14-234 THWH Stainless Steel" screws with hex-heads, ¼" shank, 2¾" or longer to suit.
    - Or approved equal.
- For securing plywood to concrete and concrete block:
  - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-½" or longer where required to suit site conditions.
  - Or approved equal.
- For securing wood blocking, cants and plywood to wood substrates:
  - Use hot dipped galvanized nails, stainless steel screws or purpose-made screws for use in preservative treated (ACQ) lumber if applicable, to provide minimum depth of penetration to underlying substrate of 1½".
- For securing perimeter flashings of prefinished metal:
  - Galvanized shingle roofing nails, 10 GA, minimum 1¼" length for in-seam nailing to wood blocking and plywood; minimum 1½".
  - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-¼" or longer where required to suit site conditions where securing into masonry/concrete/stone.
  - ColorMate (or equal) where exposed.
- For securing termination bar:

- Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-½" or longer where required to suit site conditions.
- Or approved equal.

- For securing blocking and flashing to HSS posts and other steel:
  - Stainless steel TEK screws to suit the site conditions.
- For mechanical attachment of gypsum sheathing to the metal deck:

Applicable only on metal decks.

- FM-approved plates and fasteners for metal deck installation comprised of 3" metal "truss" plates and screw fasteners of length as required penetrating deck a minimum of 1".
- Approved Products:
  - Metal plates:
    - DekFast "Galvalume Steel Hex Insulation Plate", 2-⅞".
    - Or approved equal.
  - Deck screws (for metal deck):
    - Powers Fasteners "Deck Screws", (#2613) No. 12 x 1½" (min. 1" through deck).
    - Or approved equal for metal deck.

- For securing temporary curb protection:
  - "Plastic Cap Nails" by Ideal, or by H. Paulin, or equal - 2" length.
  - The termination bar noted is a superior product. Aluminum products made for use with single-ply membranes offer little rigidity or strength.

.19 Termination bar: Pre-punched with ¼" fastening holes at 1" on centre, of 14 gauge galvanized steel.

- Approved: Sarnafil "Sarnabar", or approved equal.

.20 Wood Blocking, S4S softwood to CSA 0141-M1970.

- The first preference is to NOT use preservative treated lumber if same is ACQ treated which tends to attack many fastener types leading to premature failure due to corrosion. Since the roofing is presumed to be watertight, the blocking should be presumed to be able to endure indefinitely without being preservative treated. Specify treated lumber only if needed by project conditions. If specified, include call-out to a cut end treatment product.
- Wood blocking shall NOT be factory preservative treated.
- Sleepers shall include 6x6 timbers as detailed.
  - Utilize preservative treated lumber if the sleepers are floating above the roofing.

.21 Plywood to CSA 0121-M1978 or CSA 0151-M1978;

- Exterior sheathing grade, in dry sound condition.
- Thickness: 16 mm (5/8") except as otherwise shown on the Drawings or specified herein.
  - ½" plywood is required in locations under all curbs where abutting gypsum sheathing.
- Do not use preservative treated plywood.

.22 Cant:

Do not specify or allow fibreboard cants unless unusual site conditions demand same – a rare condition.

- 4" wood cant to be used throughout.
  - Wood to be either cedar or factory preservative treated.
  - Provide preservative brush-applied treatment for cut ends of factory treated lumber.

.23 Sealants:

- 1-component polyurethane: Sika 1A, Sika 15LM, or Tremco Dymonic, or approved equal.
- Colour as approved by the Consultant from manufacturer's standard range.

.24 Tapered High Density Fibreboard:

- For inverted roofing, this product is likely only required where there are pockets of roofing that do not slope to remote drains, or where there is a known problem with existing decking sloping away from drains.
- The industry tends to not label their fibreboard products and confirming the supplier and the density of the product is nonetheless required. Require provision of weigh bills and data sheets in submittals if this product is to be used.
- If a product is not asphalt coated both sides, including any taper-sawn faces, the quality of adhesion of the entire roof system can be poor and subject to roof blow-off. Impregnated products can be field coated if need be with the specified project primer.
- High Density impregnated and coated fibreboard to profiles and areas shown; 48" x 48" board size.
  - Approved Product:
    - ISOLtop Coated2S, or equal.
    - Product shall be asphalt impregnated and coated to reduce asphalt loss at the surface.

.25 Metal Flashing:

- Prefinished steel, 24 gauge, coating as noted below or approved equal by the Consultant.
  - VicWest "WeatherX";
  - Agway/Andex "Pre-painted Perspectra Series Coated Steel";
  - or approved equal.
  - Include the manufacturer's 40-year limited warranty (equal to or exceeding that provided with VicWest WeatherX, or Agway/Andex "Pre-painted Perspectra Series Coated Steel", etc.).
- Colour to be from manufacturer's standard colour range to be selected by the Owner upon submissions of actual metal colour samples.
- Cleats to be of same material and gauge.

.26 Miscellaneous Metal:

- 18 gauge galvanized sheet metal for closing nominal sized deck openings (if any).
- 20 gauge galvanized sheet for support of self-adhesive backed membrane as noted on the Drawings for expansion joints and similar connections across structure and between/bridging curbs.

- Provide protective covers for refrigerant lines – protecting against foot traffic, UV degradation, prolonged wetting and snow cover. Inverted U-shaped with short horizontal legs to be fixed to support blocks, and then 2 sides and top cover, custom fit.
- Secure same atop suitable sized Dura-Blok Rooftop supports or equal.
- 18 gauge galvanized sheet metal covers to protect insulated refrigerant lines from abuse, piled snow, and UV exposure.

.27 Anti-Slip Walkway Pads (for atop the expansion joints and curbs in locations shown on the Drawings):

- GenFlex "Flexguard Walkway Pad", 30"x30"x5/16".
  - GenFlex Primer.
- Alternatives will be considered; submit sample and cut sheet in advance.

.28 Mastic:

- Tremco Polyroof or approved equal for sealing stack flashings, underside of drain flanges, etc.

.29 Roof Hatch, Rails:

For roof hatches, one-handed operation is key so that the other hand and 2 feet maintain the Ministry of Labour required 3 points of contact. Include for painting of the hatch exterior. The Bilco product is generally readily available and has a complimentary style of guard. Lexcor makes similar hatches and similar guards. If the Lexcor hatch is chosen, the ease of operation can be improved by reducing the open angle from 90º to perhaps 70º – review and assess or reaching the latch to close the hatch can present a safety issue depending on hatch size. While there is a small corner bar available to aid in climbing in and out, it does not guard the unprotected opening.

- 30"x36" clear opening area, galvanized steel construction, compression spring operator, hold-open arm, one-hand operation, with top and bottom side handles and lockable at the underside – Owner to provide padlock and/or alarms as needed.
  - Approved Product: Bilco Type S-20 roof hatch, or equal.
    An open roof hatch is an "unprotected opening" and deemed a high risk for worked falls and injury. Experience shows that hatches tend to be left open during access for roof service, so guards are essential. Same guards tend to aid in climbing in and out of the open hatch by affording added balance.
- Roof Hatch Rails/Guard to fit the hatch noted above, with self-closing gate and all fittings.
  - Approved Product: Bilco "Bil-Guard 2.0" Hatch Railing System, RL-S, or equal

.30 Duct Supports:

While normally provided by the mechanical trades on new work, for restoration projects the roofer is the usual party to supply supports.

- Coordinate with mechanical sub-trade for supply and installation of Unistrut assembly complete with junctions, braces, clip angles, etc.
  - Unistrut to be 1⅝", 12 gauge (2.6 mm) galvanized.
- Dura-Blok Rooftop supports of 100% recycled rubber.
  - DBxxxxDS Series is intended and to be sized to suit.

- Equivalent products are acceptable.

.31 Pipe/Conduit Supports:

- Dura-Blok Rooftop supports of 100% recycled rubber.
  - DBP, 4" high and 10" long or as suited to site conditions.
- Or approved equal.
- Include stainless steel fasteners and suitable straps to secure pipes, conduit, etc.

.32 "Bridges" for safe service access at pipes, cable trays, ducts:
Consultant to provide design showing steps, handrails, etc., maintaining minimum unguarded offset to roof edge of 2.0 m (6'-6") at ends of each GrateWalk or equal.

- Dura-Blok GRATEWALK systems, complete, or equal.

EXECUTION

General Preparation:

.1 Adherence to the project schedule is essential.
- Coordinate all Work with the Owner.

.2 Provide all required site safety measures needed specific to the Work of this Section.
- Conduct a pre start-up safety meeting with all crew.
- Provide a written statement as to site safety and the fire watch plan; deliver copies to the Owner and Consultant.
- Identify the staff member responsible for site safety and provide contact details to the Owner and Consultant.
- If this is a re-roofing project, crew to be made knowledgeable of all issues of concern noted in the project Designated Substance Report.

.3 Conduct a pre-start meeting with the General Contractor to set out access, storage, yard, etc.

.4 Conduct a pre-start meeting with the Owner, Consultant and General Contractor to review scheduling staging of the work of this Section and by other trades and to confirm that he intended roof systems remain the best suited for the conditions at hand.

.5 Examine all preparation Work by others.
- Make review of the site conditions and coordinate with the General Contractor for any needed repairs.
- Do not commence Work until all Work by others fully satisfies the requirements of this Section.

.6 Fire Alarm:
- Coordinate with the Owner to cover and/or disable monitoring of the fire alarm in select areas for brief durations if the Work will risk triggering false alarms.
  - The Contractor will be responsible for any false alarms arising from failing to keep doors and intakes closed/covered.
  - If a fire watch is required during periods of disabled alarms, Contractor shall be responsible for same.

.7 Hot Work Permit:
- Coordinate with Owner and Consultant as to potential requirement for Hot Work Permit (such as relating to open-flame roofing operations).

Pre-Start Inspection:

.1 New concrete decks must be verified for smoothness and the General Contractor shall have same corrected as needed.

.2 Consultant must make examination and review for potential existence of Siporex or equal lightweight concrete deck panels and develop a plan with the Owner for roofing replacement and safety of workers, occupants and contents. Generally, prepare a plan to relocate occupants for the duration of any work atop such roofs.

.3 Roofer to examine for the unexpected presence of a Siporex, or equivalent, deck as might be located in isolated areas (penthouses, knock-out roof panels for future renovations, etc.).

- Coordinate with the Consultant as to action to be taken to guard against collapse, to protect occupants, to enable adhesion of membrane, to address potential plank replacements with metal deck, etc.

.4 Roofer to verify roof deck dryness by hot asphalt ladle test.

- Consultant to be present to confirm non-frothing results.

.5 Roofer to make a survey for all locations where asphalt seepage to below the deck could occur.

.6 The O.B.C. makes specific references to protecting people (occupants, or workers) from hot asphalt including that which might enter or spill into the building through voids, gaps, cracks and other openings. Asphalt at the source is often from 218ºC to 260ºC (425ºF to 500ºF) and will easily melt though many protective coverings unless carefully assessed. Safety of occupants is paramount.

- Roofer to present a plan for roof-top protection where feasible.
- Owner to coordinate to move/protect furnishings, and to relocate occupants/staff and others from any interior areas under on-going hot asphalt Work until at least past the stage of the vapour barrier installation.

.7 Inspect for and report on damage to existing surfaces, equipment, etc., both at grade and at roof-top in all areas where Work is to be conducted or staged from as relates to existing buildings.

- The Contractor shall duly record, preferably by photographs, all damages as could later be construed to have resulted from the conduct of the Work.
- All reporting must be provided to the Owner and Consultant in advance of conducting any Work.
- Elevator roofs of Siporex panels, core slab, channel slabs and others with grout between the slabs can cause debris to fall into electronics and mechanisms creating unsafe operations and costly repairs.

.8 Coordinate with the Owner to make review and inspection of elevator roofs for potential debris falling to elevator equipment, cabs, etc.

Set-Up:

.1 All Work must be undertaken with safety railings in place or with fall arrest.

.2 It is legal to work on the roof edge with travel restraint. However, this means that the safety line is taught and in-the-air holding the worker back from slipping over the roof edge – at which moment fall arrest would be essential. Inevitably, significant slack in the safety line will be found to exist and thus working at roof edges with travel restraint is not acceptable in practice.

- Simple travel restraint with carts and ropes, for example, is NOT accepted for Work at the roof edges on this project.
- All safety provisions must also satisfy Ministry of Labour requirements.
- Provide certified life safety fall arrest equipment suited to the roof type and Work conditions of the project for all Work occurring at unprotected roof edges – i.e., roof edges without railings or adequate parapet height.
- Note that a large portion of rooftop safety carts and equipment are NOT certified for use on inverted roofs. Even equipment certified for use on inverted roofs should be reviewed with concern for validity of the certification relative to the work. Inverted roofs can essentially be made into non-inverted roofs by placing the safety equipment on areas with ballast and insulation removed. Finally, note that some equipment certified for non-inverted roofs are also highly suspect and submittals and detailed experienced review by the Consultant is essential.
    - Provide test reports on life safety measures and equipment in advance of introducing equipment to the Work.
- Rescue Plan:
    - As a component of the Site Safety Plan, provide a rescue plan and equipment.
    - Ensure on-site provision for prompt rescue of any worker experiencing an arrested fall.
- NO WORK SHALL COMMENCE WITHOUT ALL SAFETY EQUIPMENT BEING IN PLACE.
- Fall arrest and travel restraint railing safety provisions shall not be removed until such time as Work by this Section and all sub-trades of this Section at the perimeters is completed and same protections are no longer required.

.9 Adhere to all provisions of the Ontario Building Code.

- The trade of this Section shall be knowledgeable of, and strictly follow or exceed the requirements of OBC Section 5.11 Hot Surface Applications.

.10 Provide to the site a kettle of adequate size to suit the Work requirements and to be operated by a trained and experience kettle operator.

- The kettle shall remain at grade, not being placed on roofs.
- The kettle shall not be left unattended at any time while in use and/or hot.
- Maintain secure fencing, minimum 6 foot high, fully around the kettle and all fuel tanks; fencing shall be kept closed.

.11 Provide engineered railings at roof edge(s).

.12 Hoisting or chuting of material to grade and disposal of same shall be coordinated to not encumber the site and the use of the building and grounds.

.13 Provide purpose-made plastic debris chutes as required, or approved hoisting equipment.

.14 Provide clean tarps to protect the building and grounds from damage, staining.

.15 As required, provide plywood coverings to windows and other building components at risk of damage in the course of the Work.

.16 Roofing crews shall have a minimum of two (2) asphalt thermometers (infra-red or submersible probe), in clean and undamaged condition.

- Temperatures must be taken at the kettle and also at the roof.

.17 Roofing crew shall not leave hot asphalt saturated mops lying on the roof at the end of use.

Preparation - Field:

.1 Pre-Start-up Inspection by the Contractor:

- General:
- Specify that inspection – cut tests, etc. – take place at all locations where site conditions are unknown and could present cost implications, especially if only exposed once work is in a critical stage.
    - In advance of commencing new Work, make examination at any odd locations and/or locations where working conditions are tight or difficult.
        - Prepare a proposed plan for enabling improved access and sound waterproofing.
        - Bring to the attention of the Consultant any and all unexpected, unforeseeable site conditions.
        - Prepare a plan for the scheduling of service interruptions and review same with the Owner in advance of affecting service.

Preparation – Mechanical, Plumbing, Electrical, Elevators:

.1 Coordination:

- Consult with the Owner and Consultant in regard to any mechanical, electrical, elevator service interruptions required in order to raise equipment or otherwise take equipment out of service.
    - Once a schedule is set for service interruptions, strictly adhere to same.
- Ensure crew is aware of air intakes and that they coordinate to disable operation of the fans during periods of time when asphalt is being mopped proximate to intakes.
    - Allow to also cover the openings with the fans off to prevent passive contamination of air in the ducting.
    - Covered intakes during fan operation risk duct or damper damage and other potentially serious problems.
    - Be certain to coordinate removal of coverings before the Owner reinstates the fans to service.
- Review project Drawings denoting extent of Work required at the mechanical units.
- Provide all M&E sub-trade labour and materials to execute the modifications to the HVAC, ducting and other roof-top mounted equipment.
- Coordinate with the Owner to terminate any abandoned services.

.2 Drains:

- Make detailed examination of the drains to determine the proper sizes and conditions of the drains to suit the site conditions.
    - Advise the Consultant as to any requirements for interior access and Work.
    - Size drains to the pipe size and not simply to the reduced size of existing retrofit/insert drains if applicable.
- Prepare piping at the building interior to allow for mechanical coupling.

Preparation – Railings:

.1 Ideally railings will be custom made hot dipped galvanized and set onto Thaler (or equal) post bases and with Thaler (or equal) flanges and large diameter ballast guards. Many of the "stock" railings are certified for use even to the roof edge, but engineering review often casts considerable doubt on the proper rating of these railings for many applications.

.2 Thaler or equal post bases are subject to engineering review by this Consultant, not the supplier or roofer – some stock bases such as the ARS-115 have been found to need upgrades. The ARS-400 has been found to be satisfactory in most cases.

.3 Custom spun aluminum "stack flashings" are often required that extend beyond the base plates and Thaler makes these without issue - and it is expected that other suppliers also can fabricate required items.

.4 Custom ballast collars are required to fit the enlarged circumference of the larger spun aluminum stack flashing. These are needed to prevent the roof ballast from punching a hole through the vulnerable (thin) spun aluminum flashing.

.5 As an alternative, in some cases where room is limited, or drainage issues exist, smaller stack flashings can be used but tapered plywood is needed all around and over the base plates.

.6 Coordinate for the placement of base plates and anchors to the deck.

Preparation – Gypsum on Metal Deck:

.1 If metal decks apply to the scope of Work, the perimeter curbs (usually 2x4 or 2x6) and cant strips should be fixed onto ½" plywood and not to gypsum board. Ideally the plywood would extend approximately 4" beyond the toe of the cant strip. Similar, but wider, plywood is required at roof curbs. Increase plywood thickness if Type X gypsum is being used.

.2 At the full perimeter of the metal deck, and at most roof penetrations/curbs, install an 12" width of ½" thick plywood (or as otherwise shown on the Drawings) to support the perimeter curbs.

- Utilize plates and screws as per gypsum but using fasteners at 16" o.c. on both edges of the plywood, staggered.

.3 Place 18 gauge metal over any nominal openings found in the deck, or at any irregular transitions of nominal length at the junction of metal deck pans.

.4 Place gypsum sheathing neatly fitted and tightly butted, with long edges parallel to the flutes, and with board edges supported on the flutes

- Stagger the sheets in adjacent rows.
- Confirm current GP Fastener Patterns (or equal supplier) source for reference. Increase fasteners for higher wind exposures, roof edges, building corner, etc.

.5 Secure with FM-approved fasteners and plates, minimum 12 per sheet, set to catch ONLY the top flutes of the deck and using fasteners that will not project a minimum of 1" but not below the level of the bottom flutes.

- Make interior inspection to verify that there is not conduit in the flutes.
- Use additional fasteners and plates at sheet edges in the event of irregularities.
- Use 15 fasteners and plates per sheet for perimeter sheets.

- Utilize the "GP Fastener Patterns" guide supplied by Georgia Pacific for 12 per sheet and 15 per sheet layout.
    - This is found at page 11 of their 20 page brochure "DensDeck Roof Boards".
- Alternatively, if an alternative equal gypsum product has been approved, utilize same manufacturer layout guide.
- If acoustic deck is in use, ensure that a joint tape or other product is specified for the gypsum to prevent asphalt seepage. Confirm the party to supply and install acoustic insulation in the flutes.

.6 For gypsum placed atop perforated acoustical metal decks, provide a proposal to the Consultant as to a method to prevent asphalt seepage – such as by taping the joints or otherwise.

Preparation – Curbs, Perimeters, Sleepers, HSS Supports, Raised Roof Penetration Boxes, Skylights, etc.:

.1 Vapour Retarder at Transitions:

- Execute work with procedures to ensure that vapour barrier transitions extend up behind walls in advance of installing wall cladding systems, and down perimeter walls, lapping over wall vapour barriers.
- Prime substrate and then extend vapour retarder membrane under and behind the woodwork of curbs/sleepers/etc. and projecting beyond same no less than 4" and otherwise as shown on the Drawings.
    - Tie-in V.B. to the perimeter walls in the most direct manner (shortest route) possible.
    - Extend membrane beneath under curbs, retaining the V.B. as close as possible to the building interior, and do not carry V.B. up and over curbs.
- For all self-adhesive backed membrane products, pressure roll with a manufacturer recommended roller (not a paint roller) in all case, full coverage, not just seams.

.2 Blocking:

- In the design of perimeter curbs, utilize time-tested and proven constructions. Avoid "innovative" cantilevers. Ensure that the curb design includes a vapour barrier at the deck level, beneath the curb, not extending up and over the curb. Ensure that the curb is insulated. Avoid HSS steel posts and/or heavy steel Z-shapes that create significant thermal bridging.
- Note that if repairs and maintenance to walls and windows require the use of swing stages, ensure that a plan is prepared to properly support same equipment relative to the curb design.
- Do not construct curbs until vapour barrier is installed behind and beneath same where shown on the Drawings and as noted above.
- Generally, unless supported equipment is temporary only and/or roof drainage is severely limited (such as narrow roofs with widely spaced drains and many curbs and sleepers that would restrict water flow), do not utilize floating curbs of wood sleepers atop the roof. Build same into the roofing, anchored to the deck.

- Construct curbs generally as shown on the Drawings – to be modified only after review and approval by the Consultant if as-built conditions expose alternatives of advantage to the project.
- Curbs, cants, plywood facings must be rigid and secure, neatly cut and fitted without gaps or twisting.
    - Bevel cut plywood and blocking where shown on the Drawings.
    - Secure cants to both the vertical curb and deck, 32" o.c. each edge, staggered.
    - Cants must be installed tight to both substrates, free of gaps, voids and twists, and must be neatly fitted.
- Tops of parapets and copings shall be sloped in accordance with conditions shown on the Drawings.
- Roof Hatches – Curb Preparation:
- The blocking should raise the base flange of the hatch to no less than the height of the roof surface so that a user's feet standing on the top rung are higher than the roof surface.
    - Provide stacked wood blocking to raise the base flange of the roof hatches to no less than the level of the top of the ballast.
    - Install cant fully around the base of the blocking/curb.
- Immediately upon setting woodwork in place, roof-in all woodwork.
    - If necessary, provide full curb protection with weatherproof covers and fully protection also for all insulation in the curbs.
    - Simple polyethylene covers will NOT be accepted.
    - Do not use a polyethylene faced self-adhesive backed material if same product is adhered since it will prevent bonding of roofing set with hot asphalt.

.3 Roof Hatches – Installation:

- Verify that roof hatch curbs are level, free of high of low corners that will cause the proper operation of the hatch to be compromised.
- Set roof hatches atop curbs with stainless steel fasteners at maximum 8" centres.
- Install ½" plywood to the face of the roof hatch in lieu of any fibreboard (loose) that could be provided with the hatch.
- Install a wood cant atop the hatch flange and onto the face of the plywood or otherwise as detailed.

.4 HSS Post Bases:

- Revise text to suit specific conditions at major mechanical supports, stair supports, railings, etc.
- Construct tapered blocking and sloped plywood bases to the HSS posts as shown on the Drawings.
- Ensure that all components are rigidly anchored and that all mitres are neatly fitted and tight.

Installation of Roofing:

.1 General:

- Do not commence installation of new roofing until receipt of approval by the Consultant of all preparation work.

- Ensure all locations subject to asphalt penetration are sealed or taped.
- Ensure Owner has made ready all interior protections, relocations to guard against damage or injury due to unpredicted asphalt intrusions if applicable.

.2 Drain Preparation:

- Ensure that the sumped areas have been prepared at drains.
    - Grind concrete around drains as needed to ensure that membrane flashed drains sit low.
- Drain flanges shall be primed both faces.

.3 Stack Flashing Preparation:

- Remove all or portions of the existing stack flashings.
- Bring to the attention of the Owner/Consultant any stack pipes found to be loose or broken.
- Wire brush or abrade any scale/rust and or bitumen or caulking to the exterior of the pipe as may affect a proper fit of the stack flashing.
- Base flanges shall be primed both faces.

.4 Membrane Installation:

- Heating of asphalt, equipment and tools, and installation of membrane, to be to applicable CRCA standards except where higher standards are set out in the Contract.
- Temperatures to be referenced are highly specific to the actual asphalt being used (supplier and supplier plant) and even more so to the Type of asphalt (i.e., Type II, Type III). EVT addresses the viscosity, measured in centipoise or cps, of the asphalt which varies by temperature. Note that the machine applied approach needs the higher temperature to feed through small holes, but same must be operated slower in order to achieve the same "thickness" of asphalt between plies. Specifying this correctly is key to providing a durable roof.
- Asphalt application (all membranes/materials):
    - Apply the IKO Easymelt 200 Type III asphalt within 17ºC (30ºF) of EVT.
        - This would be a base of 243ºC (470ºF) for application applied with a mini-mop.
        - For application by hand-mopping, use a reduced application temperature of approximately 224ºC (435ºF).
        - Temperatures noted are those at the moment the asphalt is placed on the roofing felts and not kettle of "lugger" temperature.
        - Roofer to be aware of and avoid approaching the Flash Point of the asphalt in use – 274ºC (525ºF) for EasyMelt 200.
        - If an alternative asphalt supplier has been approved, utilize same manufacturer's printed directions and as temperatures for that specific asphalt.
        - If DensDeck or approved equal gypsum is in use, Consultant must review with GP as to current maximum asphalt temperature permitted and specify asphalt that complies.
- Ensure all surfaces are clean, sound and free of any loose material before proceeding.
- Ensure all substrates are dry before proceeding.

- Prime ALL substrates (all surfaces without exception and including all curb faces, all existing membranes to be lapped, etc.).
    - Use only the specified primer.
- Apply 1 ply #15 perforated felt base membrane in advance of installing the new 4-ply BUR.
    - Asphalt shall be to no less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet per ply.
    - If the base membrane is to be left overnight, or longer, it must be fully glaze coated with hot asphalt on the day it is installed.
    - If the Contractor elects to use this base membrane as temporary waterproofing, increase to 2-ply coverage but same shall be within the Contract Price.
- At perimeters, ensure that the specified transition vapour barrier membranes or 2-ply base membrane turns up at least 8" above curbs and cants and otherwise as shown on the details.
    - The extensions of the transition V.B. will be lapped by the base membrane ply/plies.
- Apply 4 plies of glass reinforced felts and asphalt (to not less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet per ply).
    - Glass felts to carry up above the cants extending 2" to 4".
    - Within approximately 10-15 minutes (5 minutes in cold weather) of laying the glass, come back and press the membrane firmly to the contour of the cant to remove all voids behind the membrane.
    - This is an ESSENTIAL requirement of the Work.
    - No voids will be accepted in the membrane at the perimeter.
    - After ensuring tight fit of membrane to perimeter curbs, nail top of glass felts at 8" o.c. with galvanized shingle roofing nails.
- Do not walk or traffic or use equipment on freshly completed 4-ply glass field membrane.
    - Set out process to ensure against operations over freshly placed membrane.
- Curbs:
    - Apply 4 plies of #15 felts and asphalt (to not less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet).
    - Felts to carry from 8" beyond the toe of the cant and then up the curbs a minimum of 16" (all 4 plies) and with no less than 2 plies carrying over the tops and turning down 2" on the exterior face of the copings.
    - Within approximately 10-15 minutes (5 minutes in cold weather) of laying the 4-ply felt flashings, come back and press the membrane firmly to the contour of the cant and curbs to remove all voids behind the membrane.
- This is an ESSENTIAL requirement of the Work.
- No voids will be accepted in the membrane at the perimeter.
- After ensuring tight fit of membrane to the curbs, nail top of #15 felt flashings at 8" o.c. with galvanized shingle roofing nails.
- SBS Cover Sheet:

- The SBS sheet is commonly referred to as a "base sheet" in 2-ply modified bitumen (SBS) roofing. Here it is being used not as a base sheet and not as a cap sheet but rather as a protective cover sheet.
- Complete the perimeters by installing the SBS base sheet (supplied with torchable film at both faces) as a "cover" sheet extending from a minimum of 10" on the roof surface, up the wall/curb as shown on the details.
- Flame-off the thermofusible film surface (BOTH faces) and then bed in a full mopping of hot asphalt.
  - Flame must be used isolated from any wood and in conformance with current provisions of the O.B.C. and accepted standards of good practice in SBS roofing.
  - Ensure fire protection equipment is at hand.
  - Ensure that a Hot Work Permit has been obtained in advance from the Owner.
- Carry SBS sheet to a height of no less than 12" on walls as measured above the top of the cant, or as detailed on the Drawings.
  - Where possible, avoid carrying the SBS sheet over onto the top of the perimeter curbs as it can impact the fit of sheet metal, especially at corners.
- As in the case of the glass and #15 felts, press the SBS cover sheet tight to all contours to ensure against any voids.
- Nail the top edge of the SBS sheet at 8" centres using galvanized large head shingle roofing nails.
- Ensure that there is no residual thermofusible film in place that would limit the bond of the flood coat asphalt.
- Seal the top edge of the SBS sheet unless covered with the "Tie-in and Cover Flashing" over the tops of the curbs the same day.
  - Failure to do so will probably result in water behind the cover sheet and in such cases all affected sheet must be cut-out and replaced.

- Drains, Soil Stacks, etc.:
  - Take all due care to avoid drips to the building interior.
  - Seat drains and stack flashings in full back-bedding of mastic.
  - Set the drains so as to ensure full and complete support of the flanges and then secure the drain flanges to the deck.
    - In most cases, securing of the drain will be by underdeck clamping rings.
  - Apply 4 plies of #15 felts and asphalt (to not less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet).
  - Felts to carry minimum 16" beyond the flange.
  - Press the membrane firmly to the contour of the flanges of stacks and drains to remove all voids behind the membrane.
    - This is an ESSENTIAL requirement of the Work.
    - No voids will be accepted in the membrane.
- Flood Coat:
  - Before applying flood coat, ensure that all 4-ply roofing is free of blisters, ridges, lifted edges, etc.

        - Ensure also that all thermofusible film on the SBS cover sheet at curbs has been flashed off.
        - Block drains to prevent asphalt flow down drains
            - Immediately remove blocks to prevent the risk of flooding.
        - Ensure that openings/penetrations subject to potential asphalt incursion to the building have been sealed.
    - Apply a flood coating of asphalt in two separate stages to the entire roof surface at a combined rate of no less than 65 lbs. per 100 square feet and no more than 80 lbs. per 100 square feet.
    - The double-pour will be executed on 2 different days.
    - Upon completion, edge laps of the 4-ply roofing shall be minimally apparent.
- Copings, Curbs:
    - Prime all contact surfaces, avoiding staining of exposed surfaces, and apply self-adhesive backed "Tie-in and Cover Flashing" membrane across the top of curbs and copings, etc., as shown on the Drawings.
    - Tie-in and Cover Flashing membrane turns down the inside face of the curbs by a minimum of 4".
    - Tie-in and Cover Flashing membrane turns down outside face of the curb no less than 2".
        - Refer to the Drawings for lapping further onto starter metal detailing if applicable.
    - In all cases, use manufacturer recommended roller (not a paint roller) to pressure roll the membrane seams and full surface.

.5 Expansion Joints:

- Raise expansion joints minimum 4" above the top of the ballast.
- Maintain the specified movement gap.
- Do NOT utilize the commonly seen detail of a down-turned membrane "U" in expansion joints. The "U" shape collects water but cannot be sealed – there is no practical way to lap and seal membranes in the tight U profile. Instead, use flexible metal to span the joint with an upturn on one side. With movement, the apex of the angle simply flexes to allow movement. The metal allows the self-adhesive backed membrane to be installed and pressure rolled to effectively adhere and seal the seams.
- Plan the profile to match one of the proven SMACNA metal expansion joint details for the prefinished steel finish flashings.
- Carry light gauge (e.g. 26 ga.) galvanized metal across expansion joints, secured such that it will flex if the joint opens/closes.
    - This shall include at deck level for continuity of the vapour barrier, and over the top of t eh joint to provide watertightness.
    - Pressure roll the membrane.
    - Fill the gap with Roxul batt insulation.

.6 Drains:

- With the membrane work completed, set the clamping ring in place and tightly seat and secure it.
- Co-ordinate to have all drain connections made.

- Fix strainer dome and custom height ballast guards in place.
    - Note that the ballast guard must be secured/set onto the drain so as to not sit on the roof membrane and shall extend at least 2" above the ballast.
- At the building interior, install new insulation and new vapour barrier wrap, complete and sealed.

.7 Insulation:

- Separation sheet:
    - Lay polyethylene separation sheet throughout to cooled asphalt surface, lapping minimum 8" and extending up at least 4" on perimeters.
    - Neatly cutting around drains, stacks and other penetrations and projections.
- Install insulation in minimum two layers, panels staggered and staggered also by each layer.
- All insulation panels placed along cants shall have a taper cut made in the insulation as shown on the Drawings.
    - Ensure that a 1" gap is left at the full perimeter of the roofs for cooler weather insulation placement.
    - Maintain that gap while installing the insulation.
    - Do not allow ballast or other debris to enter that gap.
- Ensure that panels with broken edges and corners are not used.
- As Work proceeds, take care to not damage the roof surface.
- Upon completion, verify that all edge clearances have been maintained.
- Filter fabric:
- In some cases, a 2-ply laying of filter fabric is needed (50% overlaps) in order to limit displacement of insulation boards due to buoyancy. This is likely needed where control flow drains are used.
    - Cover insulation with filter fabric ensuring a minimum of 18" overlap at edges/ends.
        - Maintain those laps during ballasting.
        - Turn up filter fabric 16" at all perimeter flashings/curbs, penetrations, stacks and drains.
            - Tack upturns if needed to prevent ballast from
            - Upon completion of ballast and sheet metal Work, hide or trim excess fabric.

.8 Ballast:

- Install the specified ballast maintaining laps in the filter fabric and keeping filter fabric turned up at edges.
- Retain weigh bills and submit same to Consultant.
- Ballast loadings at typical and perimeter areas will vary by exposure, adhesion of roof system, flotation, etc.
- Ballast shall be to a rate of 15 psf except where otherwise noted on the Drawings of specified herein.
    - If directed by the Consultant, the Contractor shall allow to confirm this coverage by placing a 24" square "cookie cutter" onto the ballast and

weighing all contained ballast using means provided by the Contractor and as satisfactory to the Consultant.
    - This confirmation shall involve up to two locations per roof, with locations, testing/measurement being all at the discretion and to the satisfaction of the Owner/Consultant.

.9 Patio Slabs:
- Place patio slabs to the layout as noted herein and as shown on the Drawings.
    - Unless additional are shown on the Drawings, include no less than 2 slabs at tops and bottoms of ladders/stairs, and at doorways.
- Neatly saw-cut slabs to clear mechanical and other equipment and curbs.
    - Keep full and cut slabs ½" to 1" offset from curbs and equipment.
        - In no case shall slabs interfere with equipment or roofing flashings.
- Mitre cut slabs sitting on uneven bearing and subject to rocking.

Metal Flashing:

.1 New metal flashings to all areas of curbs and parapets at the perimeters and at all roof penetrations, and at all sleepers, shall be as shown on the Drawings and otherwise as reviewed with the Consultant.

.2 Verify that all curbs have proper/intended slope-to-drain.

.3 Contractor shall review with the Consultant all metal details and profiles before commencing fabrication.
- On site review and sketches or mock-ups shall be provided.
- Horizontal leg of the L-shaped edge flashing shall extend 3" under the ballast and also cover the gapped edge of the insulation (if applicable).

.4 Ensure that all metal flashings are placed over an underlayment of the "Tie-in and Cover Flashing" and as generally shown on the Drawings.
- Metal shall not be set onto exposed asphalt and felts.

.5 Ensure that all filter fabric is lifted to displace upward any ballast stone that has slipped into insulation gaps at the perimeter.
- Displace the ballast onto the roof so that the filter fabric is free of ballast and extends up the curbs before the L-shaped leg of the metal flashings are installed.

.6 Continuous cleats shall be used and shall be of the same metal and gauge as the overlaying flashings.
- Cleats shall be installed to level, straight lines and shall be shimmed as required to achieve same results.
- Proper anchorage of the cleats is key to the successful wind-tight installation of the metal flashings.

.7 All joints shall be professionally executed lock joints with fasteners set through hidden tabs.

.8 Allowance shall be made for expansion/contraction.

.9 At expansion joints, utilize a SMACNA approved detail if there is not a detail shown on the Drawings.
- Same detail would be subject to submittal of a drawing/sketch or mock-up at a preliminary stage.

.10 All edges shall be hemmed.

.11 Standing seams should be used at mitred corners.
.12 Turn up ends of the metal flashings at walls.
- Extend minimum 4" up behind siding.
- Turn up and terminate in a reglet, and seal, for termination at masonry.

.13 Exposed fasteners shall be limited to those essential by the nature of the Work and/or where indicated on the Drawings.
- Include colour-mate screws at the inner coping edge for added wind restraint.

.14 Maintain separation of dissimilar metals by using separation sheet or by back-coating.
.15 Sealants are not to be used on metal flashing joints, apart from where indicated on the Drawings and as approved by the Consultant at the request of the Contractor.
.16 Complete ballast placement over the horizontal leg of the L-shaped edge flashings.
- Leave ballast neat and of uniform thickness based on specified ballast loadings.

.17 Anti-slip Protection:
- At wide curbs and/or expansion joints in walkways where foot traffic is reasonably expected, and as shown on the Drawings, neatly cut, test-fit, prime and pressure roll into place the self-adhesive backed anti-slip protection matts.

Sundry Mechanical Work:
.1 Complete sheet metal covers for all refrigerant set lines using specified pipe support blocks.
.2 Supply and install all needed pipe, conduit and duct supports.
.3 Install any specified/designed "bridges" with steps and railings to enable safe service access over cable trays, pipes, ducts, etc.

Roof Hatches – Completion:
.1 Install pre-fabricated guards matched to the hatch frame using only stainless steel fasteners.
.2 Verify proper operation of the guard gates.
.3 Specify painting here or in a Painting Section. Exterior colour below is from 2016-18 standard but should be confirmed by the Consultant.
.4 Complete painting of the exterior of the hatch cover, and of the inner faces of the hatch sides.
- Exterior of the pre-primed hatch to be 2 coats to Owner approved standard.
- Remove stickers/labels, dirt and asphalt.
  - Benjamin Moore "Super Spec HP® D.T.M. Alkyd Semi-Gloss Enamel KP24"
  - Colour: RAL 7024 Graphite Grey (Semi-Gloss)
- Inner faces of the hatch opening to be two coats of white.
  - Benjamin Moore "Ultra Spec® 500 Interior Latex Primer" (K534) or "Fresh Start® Multi-Purpose Latex Primer" (F023)
  - Finish: Benjamin Moore "Ultra Spec 500", white.

Completion, Clean-up:
.1 Ensure that all temporarily removed/lifted equipment is put back in place with new stainless steel anchors to suit site conditions and left sealed and watertight.

.2 Ensure that all HVAC and other equipment have been put back in service and that all electrical work and service connection is complete.
.3 Verify that all drain fittings are installed and secure.
.4 If/as applicable, verify that all drain piping is properly installed, watertight and insulated and wrapped.
.5 All debris and removed equipment is to be removed and disposed of offsite.
.6 All surfaces are to be cleaned, fully, of bitumen and other stains resulting from the work.
.7 All drains are to be verified to be free flowing and unobstructed, complete.
.8 At grade, all remnants of the work shall be cleaned up, including all wind-blown insulation and other debris.
.9 Clear adjacent roofs and other surfaces of any debris from the work.
.10 Repair grade level landscaping by installing sod to any damaged grass areas affected by the Work.

Final Inspection:
.1 Verify that all Work is completed.
.2 Verify that all areas of the Work are clean and that no debris remains on site.
.3 Co-ordinate with the Consultant and Owner to conduct a final inspection.
.4 Provide completed OIRCA/CRCA warranties (roofing and sheet metal, etc.) to the Owner.
.5 Provide metal paint finish warranty to the Owner.
.6 Turn over roof hatch and roof hatch guard manuals to the Owner.

07 52 00 Modified Bitumen Roofing

General Information
.1 Modified Bitumen roofing is to be used only as necessary on Queen's projects. Such cases might be where there is simply no opportunity to utilize cants at upturns to doorways (only if same cannot be raised) or low window sills. Same systems tend to last 10-15 years, up to perhaps 20 years. However, Queen's is experiencing 30-year to 40-year durability, without leakage, with 4-ply built-up roofing (conventional and inverted)
.2 For new roofs, ensure that all roofs are accessible by roof hatches, operable/lockable windows, stairs or ladders.
.3 For new and existing roofing projects, ensure that there are fixed railings to protect where foot traffic for access and service must approach within 2.0 m (6'-6"') from a roof edge. This Consultant shall engineer the railing system and not pass that task to the Contractor.
.4 For new and existing roofing, ensure that skylights that have sills less than 42" above the roof are provided with guards to prevent falling onto (and through) the skylights – or equal protection.
.5 If premanufactured guards are proposed to be used, the engineering and design of same must be reviewed by the Consultant to confirm that the supplier data is accepted as sound for the purposes at hand.

.6 If the only solution feasible for protection is the use of fall arrest equipment, such as a fixed life line and anchors, this Consultant shall fully design and engineer same system. Where possible, utilize anchors set to walls in lieu of anchors set to the roofing.
.7 Ensure that all conduit trays, piping and ducting in the completed roofing that must be crossed by service personal are provided with safe steps/bridges and other means of passage. In some cases, where elevators and/or gas-fired equipment must be serviced, TSSA requirements should be considered. Improved lighting could be required to ensure safe trafficking of a roof at night for emergency service.

GENERAL

.1 Basic Scope:

Identify the roofs by alpha and/or numeric references. Include gross area of each roof denoting if the measure is to the inside (preferred) or outside of the curbs. Include reference to perimeter lengths to aid bidders in assessing curb flashings. Identify if measurements are from site measurement, or record drawing measurements.

- The roofs of this Section are designated as _____.
- The line below pertains not to the common "Related Sections" sentence but rather to information to be highlighted to bidders as to special coordination requirements. This could include special lifting of mechanical equipment, potential shut-downs needed due to exhaust fumes, known special events, etc.
    - Coordinate with ____
    - All other requirements of the Work are as specified and/or as noted on the Drawings.

Qualifications:

PPS/Queen's have a strict requirement for roofers as either prime or sub-contract contractors to comply with the following.

.1 The roofer shall be a member in good standing in the OIRCA and/or the CRCA.
.2 All workers for this Section shall be employees of the roofer and not sub-contractors, independent contractors, or otherwise.
.3 The full-time working foreman and lead-hand of the roofing crew shall have no less than 10 years verifiable experience in 2-ply modified bitumen roofing including mop-applied roofing utilizing SBS asphalt, torch-applied roofing, and hot air applied roofing.
.4 All workers applying membrane to the roof shall have proof of certification of training by the manufacturer of the modified bitumen roofing products in use.
.5 Sheet metal workers shall have no less than 5 years verifiable experience in the fabrication and installation of roofing sheet metal and shall be fully knowledgeable of the standards set out in the SMACNA manual.
.6 The roofer must specifically carry open-flame insurance as part of their roofing insurance coverage.

Warranty:

The roofing contractor associations limit warranties to 2 years. Specify a longer "system warranty" from the supplier – but same have many limitations and place requirements on the Owner that are not always understood. Same should be for a duration of 20 years if available and might be best specified as an Option Price so the Owner can assess cost vs. value.

.1 The Contractor shall warrant all labour and workmanship, complete, so as to ensure the soundness and continued watertightness of the completed Work for a period of two (2) years.
.2 The roofing warranty document shall be the standard OIRCA or CRCA warranty duly executed by the member roofer and provided to the Owner.
.3 Warranty requirements include also the proper performance of the prepainted metal as follows.
- This shall include the manufacturer's 40-year limited warranty (equal to or exceeding that provided with VicWest WeatherX, or Agway/Andex "Pre-painted Perspectra Series Coated Steel").
- This shall include for 2 years for the complete wind-tight security of the metal flashings.
- For larger projects, cross reference the related Sections. This could be for Metal Flashings and Trim, other Roofing Sections, etc.

.4 For additional requirements and clarifications, refer to:
- Section _____.

Reference Standards:

The following 2 sub-sentences are the most important as the below referenced documents are inclusive.

.1 Except where explicit directions are given in the Contract documents, do all roofing work in accordance with applicable CRCA and NRCA standards as set forth in the CRCA Roofing Specifications Manual and applicable NRCA manuals.
.2 In addition, execute all Work in accordance with the modified bitumen roofing manufacturer's latest published instructions.
- 1.4.2.1 Where manufacturer and CRCA specifications are in conflict or differ, presume the more stringent to apply as to costing, and identify to the Consultant any issues impacting the warranty.

.3 Except where explicit directions are given in the Contract documents, do all sheet metal work in accordance with applicable SMACNA and/or CDA standards.
- Delete all inapplicable sub-sentences within 1.4.4 through 1.4.11 – which is expected to be most of the sub-sentences.

.4 ASTM International Inc.
- ASTM C726-[05], Standard Specification for Mineral Fiber Roof Insulation Board.
- ASTM C728-[05], Standard Specification for Perlite Thermal Insulation Board.
- ASTM C1002-[07], Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

- ASTM C1177/C1177M-[06], Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- ASTM C1396/C1396M-[06a], Standard Specification for Gypsum Board.
- ASTM D41-[05], Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- ASTM D226-[06], Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- ASTM D312-[00(2006)], Standard Specification for Asphalt Used in Roofing.
- ASTM D448-[03a], Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- ASTM D450-[07], Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.
- ASTM D1863-[05], Standard Specification for Mineral Aggregate Used on Built-Up Roofs.
- ASTM D2178-[04], Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
- ASTM D4601-[04], Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
- ASTM D6380-[03], Standard Specification for Asphalt Roll Roofing (Organic Felt).

.5 Canadian General Standards Board (CGSB)

- CGSB 37-GP-9Ma-[83], Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

.6 Canada Green Building Council (CaGBC)

- LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
- LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

.7 Canadian Standards Association (CSA International)

- CSA A123.2-[03], Asphalt-Coated Roofing Sheets.
- CSA A123.3-[05], Asphalt Saturated Organic Roofing Felt.
- CSA A123.4-[04], Asphalt for Constructing Built-Up Roof Coverings Waterproofing Systems.
- CSA A123.16-[04], Asphalt-Coated Glass Base Sheet.
- CSA A123.17-[05], Asphalt Glass Felt Used for Roofing and Waterproofing.
- CSA A123.21-[04], Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- CSA A231.1-[06], Precast Concrete Paving Slabs.
- CAN/CSA-ISO 9001-[00], Quality Management Systems - Requirements.
- CAN/CSA-ISO 14001-[04], Environmental Management Systems - Requirements with Guidance for Use.

- CSA O121-[08], Douglas Fir Plywood.
- CSA O151-[04], Canadian Softwood Plywood.

.8 Canadian Roofing Contractors' Association (CRCA)

- CRCA Roofing Specifications Manual - [1997].

.9 Factory Mutual (FM Global)

- Reference to FM approvals requires that the Consultant have comprehensive knowledge of same standards and how specified materials/assemblies must exactly match tested assemblies – which are not likely to be those in use on many PPS/Queen's projects. This is not something for the Contractor to have any role in as to levels, components, assemblies, etc. DELETE 1.4.9 if it is not to be used.
- FM Approvals - Roofing Products.

.10 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- Material Safety Data Sheets (MSDS).

.11 Underwriters' Laboratories of Canada (ULC)

- CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- CAN/ULC-S702.2-[03], Standard for Mineral Fibre Thermal Insulation for Buildings.
- CAN/ULC-S704-[03], Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- CAN/ULC-S706-[02], Standard for Wood Fibre Thermal Insulation for Buildings.

Environmental Requirements:

.1 Conduct Work only during dry weather conditions and as set forth to be satisfactory herein and to the membrane and roofing materials suppliers.

.2 Ensure that all materials introduced to the roofing system are dry, clean and undamaged.

Delivery, Storage and Handling:

.1 All products delivered to the site shall be as set out in the Specifications or otherwise as explicitly approved in writing by the Consultant in advance of delivery to the site.

.2 All products shall be stored with labels in place.

- Weigh bills shall be provided upon delivery of products that inherently do not have labels (such as ballast, etc.).

.3 Roof insulation must be protected and stored secure from wind blow off and undue weathering, wetting of edges, warping, edge damage, etc.

.4 Membrane rolls should be stored on end with adequate supports.

- Membrane rolls must be maintained above any moisture that could impact the rolls including rain, snow and splash.

.5 Store adhesives and caulking in sealed, labeled containers and at temperatures above +5C.

- Do not store flammable products in Queen's buildings, penthouses, etc.

.6 All board goods (insulation, fibreboard, gypsum sheathing, plywood, etc.) and all lumber products must be tarped with breathable water repellant covers and kept on raised sleepers during storage.
- Do not store under polyethylene or other non-breathable covers that will subject covered products to wetting from condensation.

Protection:

.1 Seal the perimeters of the membrane at the end of each working day to prevent water infiltration into the roof system and/or building.

.2 At no time are perimeter wood curbs, or other woodwork, be left exposed to direct or indirect weathering.
- All woodwork MUST be protected with roofing materials, not polyethylene, the same day that the woodwork is installed.

.3 Adequate care shall be taken by all trades to protect the installed membrane from damage.
- Care MUST be taken to not traffic across fresh BUR.

.4 Protect the building interior and adjacent exterior surfaces from damage, asphalt, staining.

Submittals:

.1 Products:
- Submit product data sheets only if being alternatives approved from those listed herein.
- If high density tapered (or uniform thickness) fibreboard is to be used in the Work, include product data sheets in advance of ordering product.

.2 Schedule:
- Provide a detailed update of the roofing portion of the project schedule as submitted with the project tender.
  - Include reference to crew size, working foreman, lead-hand, etc.
  - Make clear indication as to when and where mechanical and electrical equipment will need to be out of service in a manner satisfactory to the Owner's operations.
  - Make clear indication as to when and where sheet metal work will commence with clear indications as to working periods required to reach completion.
  - Site clean-up and staging will be reviewed and coordinated to minimize impact.
  - Identify all areas of coordination with other trades and with the Owners and make note of all potential interruptions of service, shut-downs.
- Provide a proposed breakdown of components of the Work for progress billing purposes.
  - Include:
  - Edit to suit job requirements.
    - Bonds, insurance, Permit(s);

- Mobilization, site protection, site access, crane, light standards relocated, temporary security lighting, walk-through scaffold to all entry and exit locations;
- Hazardous materials abatement, disposal;
- Roof demolition, tear-off, disposal, recycling;
- Vapour barrier (transitions), carpentry, curb insulation;
- Raising of door thresholds where existing are low;
- Raising of skylights (curbs) where existing are low;
- Life safety anchors, railing bases, roof hatches;
- Duct removal and preparation;
- Roof membrane installation, drains, mechanical and electrical;
- Roof insulation and ballasting, pavers;
- Sheet metal flashings;
- Completion of railings;
- Penthouse cladding;
- Final cleaning, as-built drawing preparation and submittals, O&M manual submittals;
- Demobilization, site restoration including hard and soft landscape, etc.

.3 Samples:

- Aggregate surface colour for the SBS cap sheet.
  - Samples shall be in duplicate and minimum 4" x 4"
- Metal Colour(s):
  - Upon commencing the project, submit one (1) actual sample of each colour of sheet metal required to be used in the Work.
    - Samples shall be minimum 1½" x 3".
    - Provide confirmation of the paint/coating grade and the gauge of the base metal to be supplied.
      - Include supplier name.
      - Include sample 40-year warranty.

.4 Shop Drawings, Sketches, and/or Mock-ups:

- For sheet metal Work, shop drawings or sketches should be provided upon commencing roofing Work.
- If upon review with the Contractor the Consultant provides written acceptance that mock-ups can be provided in lieu of drawings/sketches, then same shall be prepared, revised as needed, and accepted by the Consultant before sheet metal fabrication commences.
  - If a mock-up is being done to show assembly of components, but the colour and/or base metal thickness/type does not exactly match the specifications, then Consultant approval, if given, is limited solely to the general assembly and not to metal, thickness, coating product, colour, etc.

.5 Products:

- Submit full listing of products to be provided.
  - Where same match the specifications, include only in list format, do not include Product Data sheets at this stage.
  - Include the listing of fasteners.

- Alternate Products:
    - It is not expected that alternate products will be provided or proposed.
    - The Contractor shall be certain to allow time and resources to secure all specified products for on-time delivery.
    - Confirm below the Division 1 Section number applicable.
    - If circumstances of delivery, or manufacturing problems, etc., arise beyond the control of the Contractor, and not being due to late or inadequate planning, then submittals for Alternates shall be as set out in Section 01 33 00, Submittal Procedures.
    - Submittals must include clean Product Data sheets for specified and proposed alternative products.
    - Submittals must show clear reference to the proposed products matching specified product performance data and characteristics.
    - Submittals must show the cost variance information including supplier invoices upon demand by the Consultant.
    - Upon demand by the Consultant, the Contractor shall provide physical samples of the alternate products being proposed.

.6 MSDS:

- Provide MSDS sheets on all products of the Work including primary roofing materials as well as primers, adhesives, solvents, cleaning products, etc.
- Submit to the Owner duplicate clean copies of current data sheets and bind in 3-ring, Cerlox or similar folders.
    - Maintain additional MSDS documentation at the site for reference by the work crews.

PRODUCTS

The system shall be subject to advanced preview by the Owner. Given alternative roofing methods (such as 4-ply BUR) preferred by Queen's, it will be presumed that door or window sills are located minimally above the deck – preventing the use of cant strips.

Waterproofing System Description

Note that for expected conditions of application to a concrete deck, there would presumably not be insulation – or other preferred systems would be utilized instead. The following are listed only for possible rare site conditions.

.1 2-ply No. 15 perforated felt and Type III asphalt vapour barrier.

.2 Polyisocyanurate insulation with coated glass facers (both faces), hot mopped with Type III asphalt, or in Soprema "SOPRASPHALTE™ M" SEBS bitumen, or approved equal SEBS bitumen.

.3 Tapered polyisocyanurate insulation with coated glass facers (both faces), hot mopped with Type III asphalt, or in Soprema "SOPRASPHALTE™ M" SEBS bitumen, or approved equal SEBS bitumen.

.4 Cover board of 1" thick asphalt impregnated and coated high density fibred board, hot mopped with Type III asphalt, or in Soprema "SOPRASPHALTE™ M" SEBS bitumen, or approved equal SEBS bitumen.
Note that if alternatives to noted products are permitted, there could be difficulty achieving the high-performance characteristics and the time-proven durability of same

products. In the Pricing portion of the Form of Tender, include reference to Option costs to go to the alternate product but the Base Bid should likely be comprised of the noted products to ensure competitive bids.

.5 Base Sheet and Base Sheet Flashings:
- Soprema "Colply Base 410" SBS modified bitumen membrane, 2.5 mm thick, sanded both faces, or approved equal product.
- Mopped in Soprema "SOPRASPHALTE™ M" SEBS bitumen, or approved equal product as applicable.
- Primer for Base Sheet:
  - Soprema "Elastocol 500" subject to review of site conditions with Soprema and the Consultant.
  - Or approved equal manufacturer specified primer.
  - For roofs that will NOT be exposed to traffic and UV, do NOT utilize a granulated cap sheet. That sheet adds considerable complexity and cost, and risks reduced durability – simply because embedding granules takes time and risk imperfections and is commonly associated with leaks. Instead, for non-trafficked systems and those not exposed to UV, utilize a cap sheet comprised instead of a second base sheet.

.6 Cap Sheet and Cap Sheet Flashings
- For exposed cap sheet membrane: Soprema "Colply Traffic Cap 460" SBS modified bitumen membrane, 3.5 mm thick, sanded underface, granulated top face, or approved equal product.
- Mopped in Soprema "SOPRASPHALTE™ M" SEBS bitumen, or approved equal SEBS asphalt.
- Granulated surface to colour selected by Owner from the standard colour range.
  - Contractor to confirm colour with the Owner at least 6 weeks in advance of the Work of the cap sheet installation so as to ensure delivery.
  - A suitable alternative to the above noted Colply 410/460 membrane would be a Sopraply 510 base, mopped in with Soprema "SOPRASPHALTE™ M" SEBS bitumen, and a Sopraply 560 cap sheet, torch-applied. Both are high performance membranes. Alternative products from other manufacturers, with proven high performance characteristics and durability, are satisfactory.

Materials:

.1 The products and components of the roofing system shall be compatible products for use in 2-ply SBS roofing systems.

.2 Generally, use only products only from a single manufacturer to ensure compatibility.

.3 Ideally reference the Consultant's manufacturer representative to help ensure that the manufacturer's input to the project is coordinated.
- The manufacturer's representative for the Consultant is:
  - Name: _____
  - Phone: _____
  - Email: _____

.4 Bitumen/Asphalt:
- For vapour barrier, and for insulation and cover board/panel installation:

- IKO EasyMelt 200 Type III asphalt, or approved equal.
- Type III is NOT to be used with the SBS base and cap sheets.

- For SBS base and cap sheet membrane installation:
  - Soprema "SOPRASPHALTE™ M" SEBS bitumen, or SEBS asphalt from the approved equal membrane system manufacturer.

.5 Primer:

.6 The specified primer is a premium quality product (at a premium price), that has been site tested and proven to provide significantly improved performance to aid in adhering of roofing products. Products known to the Consultant to be equal are satisfactory.

- Soprema "Elastocol 500" for all exposed membrane, gypsum, concrete, wood and metal surfaces.
- Or approved equal high performance product compatible with the membrane.

.7 Vapour Barrier (field):

- No.15 perforated felt base ply / vapour barrier BUR with Type III asphalt.
- This must be 2-ply if being retained for short-term waterproofing.
- This must also be glaze-coated if left overnight or longer.

.8 Vapour Retarder (transition membrane – under curbs, at up-stands, etc.):

- The Contractor can utilize No.15 perforated felt base ply / vapour barrier BUR with Type III asphalt for this application but at transitions it shall be at least 2-ply.
- Alternates:
  - Self-adhesive backed and with thermofusible film top face.
    - Approved Products:
      - Soprema "Sopraflash Flam Stick" (self adhesive backed, thermofusible film top face), or other product as approved in writing by the Consultant.
  - Film MUST be flashed off.
  - Or approved equal membrane.
  - Primer:
    - Soprema "Elastocol Stick", or other product as approved in writing by the Consultant.
    - Soprema "Elastocol 500", or other product as approved in writing
    - Or approved equal primer from the membrane manufacturer.
- Failing to flash-off the film will prevent bonding of the membrane with hot asphalt – asphalt is simply not hot enough compared to torch application temperatures.
- Flammable film must be flashed off in the case of the bottom and/or the top face when mopping is used for adhesion.
- Use this membrane or "Sopraguard Tape", or approved equal flame protection as required to seal penetrations to the building.

.9 Modified Bitumen Membranes:

- As noted above

.10 Tie-in and Cover Flashing at Copings, HVAC curbs, etc.:

- For flashing completely over top of ALL curbs/parapets and at HVAC curbs, up-stands, etc.:
  - Self-adhesive backed membrane, self-sealing at fasteners, with high density cross-laminated polyethylene facing.

        - This membrane seals at fasteners and isolates the metal flashings from the underlying asphalt (and granulated cap sheet) membranes.
        - "High temperature" grade underlayment membranes are NOT required and were developed for use under low emissivity, high absorption metals in climates like that of Arizona. Approved products below exceed ASTM required 70ºC for underlayments and can in fact reach 90ºC and higher. The HT grade products will test to perhaps 140ºC to 150ºC – but those requirements are not encountered here in 4-ply roofing applications. It is though not detrimental, other than excessive cost, to use HT grade alternatives. If, however, prolonged (greater than 90 day) direct exposures to the weather/UV is expected, then the HT products might be merited but must be approved in writing by the manufacturer on a case-by-case basis.
    - Approved products:
        - Grace Construction Products "Ice & Water Shield", rubberized asphalt.
        - Soprema "Sopraseal Stick 1100 T" (1.0 mm thick, polyethylene woven reinforcing and SBS modified bitumen) and primer as set out for "Sopraflash Stick" above.
            - Care must be taken to use the winter or summer grade product applicable to the Work conditions.
        - Or approved high quality self-adhesive backed underlayment.
    - Any proposal for alternates must satisfy a required exposure to UV/weather of at least 90 days as satisfactory to the manufacturer.

.11 Temporary curb protection:

- To be used where wood and curbs (whether insulated or not) must be protected from adverse weather in advance of installing the above-noted "Tie-in and Cover Flashing".
- Approved Products:
    - Tyvek, Typar or similar wind-secure and watertight sheet.
    - Use "plastic cap nails" for securing temporary curb protection.
    - Standard polyethylene will not be accepted.

.12 Insulation:

It is NOT expected that Queen's would seek to utilize modified bitumen roofing in a conventional roof system (i.e., SBS membrane atop insulation). However, in circumstances that could necessitate such a system, references are included to insulation.

Coated glass facers (CGF) are recommended over non-coated glass facers (AGF), and certainly over any products with non-glass (e.g., cellulose, organic) facers.

- Polyisocyanurate:
    - Size: 48"x48" panels – do not increase panel size.
    - Utilize multiple layers in lieu of single thicker layers as this product is subject to significant seasonal thermal movements that should not be

allowed to transfer through the overall depth of the insulation, and must be avoided to limit stress/ridging at the membrane.
    - Thickness: two (2) layers to achieve required thickness – _____.
    - Approved Products:
      Utilize the Shiplap designation below only for roofs of considerable insulation thickness and where this will not be the only layer of polyisocyanurate insulation. Utilize the same product without the Shiplap designations where thinner insulation panels are needed – and always in multiple layers.
        - Soprema "Sopra-ISO Plus Shiplap" with polymer coated glass facers, or,
        - Johns Manville "ENRGY 3® CGF", faced both sides with glass fibre reinforced facers, coated, or,
            - Grade 3 – high density of 25 psi
        - Atlas Roofing "ACFOAM-III", faced both sides with glass fibre reinforced facers, coated or,
        - Equivalent product as approved by the Consultant in writing.
- Tapered Insulation:
  Utilize tapered polyisocyanurate, with CGF both faces, only under 1" HD fibreboard cover board. This is NOT preferred to tapered HD impregnated/coated fibreboard – see following.
    - Utilize product faced both sides exactly matching the polyisocyanurate insulations above.
- Tapered High Density Fibreboard:
    - High Density impregnated and coated fibreboard to profiles and areas shown; 48" x 48" board size.
        - Approved Product:
            - ISOLtop Coated2S or equal
            - Product shall be asphalt impregnated and coated to reduce asphalt loss at the surface.
- Insulation Adhesive:
- Certified by the adhesive manufacturer for use with the utilized insulation product(s).
    - Soprema DuoTack 365, or approved equal product from the insulation manufacturer, especially when machine applied and when bead size and bead spacing is closely monitored, and when insulation panels are IMMEDIATELY installed as the adhesive is placed, is fully satisfactory. However, full bed hot asphalt moppings provide 100% coverage in lieu of less than 10% coverage of the adhesive approach. This full coverage approach can be critical to ensuring against gaps in the insulation and cover board, and ridging of the membrane. Careful review of alternative approaches should be made for each project.
- Approved products:
    - Soprema "DuoTack 365", or,
    - Hot applied Type III asphalt (IKO EasyMelt 200 or approved equal), or,
    - Other product approved by the insulation manufacturer.

.13 Cover Board:

- High density fibreboard, 4'x4' boards, 1" thickness.
  - Review with Consultant before making a possible change in board panel size.
  - Asphalt impregnated and coated to reduce asphalt loss at the surface and promote adhesion.
    - Approved Product:
      - MSL "ISOLtop Coated2S" (of Louiseville Québec), or equal

.14 Sundry:

- Soprema "Sopraguard Tape" for isolated added flame stop, or approved equal product..
- "Granules in Bulk", colour to match cap sheet.
- End lap adhesive: Soprema "Colply Trowel Grade" adhesive, or as recommended by the approved equal membrane manufacturer.
  - Needed only if mopped cap sheet will be left exposed and visible

.15 Drains (_____ required):

Contrary to industry practices, it is ideal that the roofer should supply the drains and direct their installation as they are the most knowledgeable party in most cases as to roof drain products, accessories and required installation practices.

- Thaler Metal Industries RD-4C drains complete with:
- The Thaler drain noted is time-proven, Ontario-made, and Thaler is a supplier able to execute products with significant customization. The drain should be ordered in copper and the strain dome in cast. Do NOT utilize retrofit (insert) drains unless circumstances require same. If the ferrule is soldered to the drain system on delivery, it is possible it will not fit a site condition where the lateral pipe and elbow is tight to the underside of the deck.
  - vandal-proof cast aluminum dome with hinged access gate clamped directly to drain body;
  - .090" (2.3 mm) pan-formed copper drain body, deck flange and straight copper outlet with ferrule (not soldered in place to facilitate site custom fitting and subsequent soldering);
  - 3/8" (9 mm) bolts soldered to drain;
  - cast aluminum stabilizer ring;
  - underdeck clamping ring and fittings;
  - bituminous painted deck flange.
  - Contractor shall confirm all sizes and site conditions and coordinate with plumber before ordering.
  - The Jay R. Smith drain noted below has also been used with durable success at Queen's. The Consultant needs to identify required components. If flow-control is required, the Consultant needs to establish where same fitting shall be placed (at the deck level, at the top of the collar, etc., depending on the roofing system characteristics).
- Alternate Drain
  - Jay R. Smith Raintrol 1017, CID, U, C, R, HGS, __" size, and associated characteristics.

        - The Sump Receiver ("R") to be used on all metal decks with gypsum sheathing, on wood decks, and on light-weight precast concrete decks.
        - Or approved equal drain products.
    - All piping, fittings, adapters, hangars – if/as required.
    - All pipe insulation and vapour barrier wrap at interior.

.16 Soil stacks, Exhaust and penetration flashings (_____ required):

- For soil stacks and similar penetrations, provide spun aluminum insulated flanged soil stack type flashings
    - Provide insulated sleeves unless intended for hot pipes and/or unless existing pipes have collars/junctions above the deck.
- Approved product:
    - Thaler SJ-38 (13") or SJ-39 (19") Stack Jack™ Flashing (insulated); or equal to suit site conditions and sizes.

.17 Hot pipe flashings (___ required):

- Provide hot pipe weather collars, separate to the flashings, and vented where applicable.
- Approved product:
    - Thaler MEF-3A hot pipe flashings; 18" aluminum stack; stainless steel weather collar and fittings; mineral wool where permitted; or equal to suit site conditions and sizes.

.18 Gypsum Sheathing:

Applicable only on metal decks. Consultant to ensure that approved product is temperature-compatible with asphalt application temperatures,

- Georgia-Pacific "DensDeck Prime® Roof Board", 1/2" thick.
- Or approved equal product.

.19 Fasteners:

- General:
    - All fasteners to be corrosion resistant.
    - Any fasteners in contact with preservative treated lumber MUST be purpose-made for use with preservative treated lumber.
    - Alternate suppliers for the fastener types listed below will be considered.
- For securing wood blocking to concrete and concrete block:
    - Approved screw anchor products:
        - Powers Fasteners (905-673-7295 or 514-631-4216) Type 304 Stainless Steel "Tapper", ¼" x 2¾" or longer to suit.
        - Hilti "KWIK-CON II+ 14-234 THWH Stainless Steel" screws with hex-heads, ¼" shank, 2¾" or longer to suit.
        - Or approved equal.
- For securing plywood to concrete and concrete block:
    - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-½" or longer where required to suit site conditions.
    - Or approved equal.
- For securing wood blocking and plywood to wood substrates:

- Use hot dipped galvanized nails, stainless steel screws or purpose-made screws for use in preservative treated (ACQ) lumber if applicable, to provide minimum depth of penetration to underlying substrate of 1½".

- For securing perimeter flashings of prefinished metal:
  - Galvanized shingle roofing nails, 10 GA, minimum 1¼" length for in-seam nailing to wood blocking and plywood; minimum 1½".
  - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-¼" or longer where required to suit site conditions where securing into masonry/concrete/stone.
  - ColorMate (or equal) where exposed.
- For securing termination bar:
  - Powers Fasteners (905-673-7295 or 514-631-4216) "Zamac Nailin" mushroom head pin anchors, with carbon steel nail, ¼" x 1-½" or longer where required to suit site conditions.
  - Or approved equal.
- For securing blocking and flashing to HSS posts and other steel:
  - Stainless steel TEK screws to suit the site conditions.
- For mechanical attachment of gypsum sheathing to the metal deck: Applicable only on metal decks.
  - FM-approved plates and fasteners for metal deck installation comprised of 3" metal "truss" plates and screw fasteners of length as required penetrating deck a minimum of 1".
  - Approved Products:
    - Metal plates:
      - DekFast "Galvalume Steel Hex Insulation Plate", 2-⅞".
      - Or approved equal.
    - Deck screws (for metal deck):
      - Powers Fasteners "Deck Screws", (#2613) No. 12 x 1½" (min. 1" through deck).
      - Or approved equal for metal deck.
- For securing temporary curb protection:
  - "Plastic Cap Nails" by Ideal, or by H. Paulin, or equal - 2" length.

.20 Termination bar: Pre-punched with ¼" fastening holes at 1" on centre, of 14 gauge galvanized steel.

- Approved: Sarnafil "Sarnabar", or approved equal.

.21 Wood Blocking, S4S softwood to CSA 0141-M1970.

The first preference is to NOT use preservative treated lumber if same is ACQ treated which tends to attack many fastener types leading to premature failure due to corrosion. Since the roofing is presumed to be watertight, the blocking should be presumed to be able to endure indefinitely without being preservative treated. Specify treated lumber only if needed by project conditions. If specified, include call-out to a cut end treatment product.

- Wood blocking shall NOT be factory preservative treated.
- Sleepers shall include 6x6 timbers as detailed.

- Utilize preservative treated lumber if the sleepers are floating above the roofing.

.22 Plywood to CSA 0121-M1978 or CSA 0151-M1978;

- Exterior sheathing grade, in dry sound condition.
- Thickness: 16 mm (5/8") except as otherwise shown on the Drawings or specified herein.
  - ½" plywood is required in locations under all curbs where abutting gypsum sheathing.
- Do not use preservative treated plywood.

.23 Sealants:

- Sika 1A, Sika 15LM, or Tremco Dymonic, or approved equal.
- Colour as approved by the Consultant from manufacturer's standard range.

.24 Precast Concrete Pads (patio slabs – ___ required):

.25 Modern 24" pavers tend to be "dry cast – i.e., fabricated from "mortar" placed in forms, shaken, and then stripped in quick succession. The shaking nullifies any attempt at air entrainment and durability is diminished. The specified product should be a wet-cast cement with a pattern surface for slip resistance, air entrainment and fibre reinforcing,

- 24"x24"x1⅝" (nominal) thick precast (wet-cast) concrete slabs, of uniform thickness, 5% air entrainment, fibre reinforcing, and skid-resistant finish texture.
  - Approved product: Available from Planes Precast Concrete Limited, 1190 McAdoo's Lane, Kingston – lead time could be required.
  - Or approved equal.
  - Dry pack" products and products of other thickness not permitted.

.26 Metal Flashing:

- Prefinished steel, 24 gauge, coating as noted below or approved equal by the Consultant.
  - Include the manufacturer's 40-year limited warranty (equal to or exceeding that provided with VicWest WeatherX, or Agway/Andex "Pre-painted Perspectra Series Coated Steel", etc.).
  - Approved products:
    - VicWest "WeatherX"; or,
    - Agway/Andex "Pre-painted Perspectra Series Coated Steel"; or,
    - Approved equal.
- Colour to be from manufacturer's standard colour range to be selected by the Owner upon submission of actual metal colour samples.
- Cleats to be of same material and gauge.

.27 Miscellaneous Metal:

- 18 gauge galvanized sheet metal for closing nominal sized deck openings (if any).
- 20 gauge galvanized sheet for support of self-adhesive backed membrane as noted on the Drawings for expansion joints and similar connections across structure and between/bridging curbs.
- Provide protective covers for refrigerant lines – protecting against foot traffic, UV degradation, prolonged wetting and snow cover. Inverted U-shaped with short horizontal legs to be fixed to support blocks, and then 2 sides and top cover, custom fit.

- Secure same atop suitable sized Dura-Blok Rooftop supports or equal.
- 18 gauge galvanized sheet metal covers to protect insulated refrigerant lines from abuse, piled snow, and UV exposure.

.28 Anti-Slip Walkway Pads (for atop the expansion joints and curbs in locations shown on the Drawings):

- GenFlex "Flexguard Walkway Pad", 30"x30"x5/16".
  - GenFlex Primer.
- Alternatives will be considered; submit sample and cut sheet in advance.

.29 Mastic:

- Tremco Polyroof or approved equal for sealing stack flashings, underside of drain flanges, etc.

.30 Duct Supports:

While normally provided by the mechanical trades on new work, for restoration projects the roofer is the usual party to supply supports.

- Coordinate with mechanical sub-trade for supply and installation of Unistrut assembly complete with junctions, braces, clip angles, etc.
  - Unistrut to be 1⅝", 12 gauge (2.6 mm) galvanized.
- Dura-Blok Rooftop supports of 100% recycled rubber.
  - DBxxxxDS Series is intended and to be sized to suit.
  - Equivalent products are acceptable.

.31 Pipe/Conduit Supports:

- Dura-Blok Rooftop supports of 100% recycled rubber.
  - DBP, 4" high and 10" long or as suited to site conditions.
- Or approved equal.
- Include stainless steel fasteners and suitable straps to secure pipes, conduit, etc.

.32 "Bridges" for safe service access at pipes, cable trays, ducts:

.33 Consultant to provide design showing steps, handrails, etc., maintaining minimum unguarded offset to roof edge of 2.0 m (6'-6") at ends of each GrateWalk or equal.

- Dura-Blok GRATEWALK systems, complete, or equal.

EXECUTION

General Preparation:

.1 Adherence to the project schedule is essential.

- Coordinate all Work with the Owner.

.2 Provide all required site safety measures needed specific to the Work of this Section.

- Conduct a pre start-up safety meeting with all crew.
- Provide a written statement as to site safety and the fire watch plan; provide copies to the Owner and Consultant.
- Identify the staff member responsible for site safety and provide contact details to the Owner and Consultant.
- If this is a re-roofing project, crew to be made knowledgeable of all issues of concern noted in the project Designated Substance Report.

.3 Conduct a pre-start meeting with the Owner, Consultant and General Contractor to set out access, storage, yard, etc.

.4 Conduct a pre-start meeting with the Owner, Consultant and General Contractor to review scheduling staging of the work of this Section and by other trades and to confirm that he intended roof systems remain the best suited for the conditions at hand.

.5 Examine all preparation Work by others.

- Make review of the site conditions and coordinate with the General Contractor for any needed repairs.
- Do not commence Work until all Work by others fully satisfies the requirements of this Section.

.6 Coordinate with the Consultant through-out the project to ensure that all required site inspections are made.

- Coordinate also with the membrane supplier's representative to ensure that Warranty requirements are satisfied.
- Provide minimum 3 working days advance notice of work commencing or continuing and or of needed inspections.

.7 Fire Alarm:

- Coordinate with the Owner to disable monitoring of the fire alarm in select areas for brief durations if the Work will risk false alarms due to making roof access holes or similar.
    - The Contractor will be responsible for any false alarms arising from failing to keep doors and intakes closed/covered.
    - If a fire watch is required during periods of disabled alarms, Contractor shall be responsible for same.

.8 Hot Work Permit:

- Coordinate with Owner and Consultant for Hot Work Permit.

Set-Up:

.1 All Work must be undertaken with safety railings in place or with fall arrest.
It is legal to work on the roof edge with travel restraint. However, this means that the safety line is taught and in-the-air holding the worker back from slipping over the roof edge – at which moment fall arrest would be essential. Inevitably, significant slack in the safety line will be found to exist and thus working at roof edges with travel restraint is not acceptable in practice.

- Simple travel restraint by carts and ropes, for example, is NOT accepted for Work at the roof edges on this project.
- All safety provisions must also satisfy Ministry of Labour requirements.
- Provide certified life safety fall arrest equipment suited to the roof type and Work conditions of the project for all Work occurring at unprotected roof edges – i.e., roof edges without railings or adequate parapet height.
- Note that a large portion of rooftop safety carts and equipment are NOT certified for use on inverted roofs. Even equipment certified for use on inverted roofs should be reviewed with concern for validity of the certification relative to the work. Inverted roofs can essentially be made into non-inverted roofs by placing the safety equipment on areas with ballast and insulation removed. Finally, note that some equipment certified for non-inverted roofs are also highly suspect and submittals and detailed experienced review by the Consultant is essential.

    - Provide test reports on life safety measures and equipment in advance of introducing equipment to the Work.
  - NO WORK SHALL COMMENCE WITHOUT ALL SAFETY EQUIPMENT BEING IN PLACE.
  - Fall arrest and travel restraint railing safety provisions shall not be removed until such time as Work by this Section and all sub-trades of this Section at the perimeters is completed and same protections are no longer required.

.2 Adhere to all provisions of the Ontario Building Code.
  - The trade of this Section shall be knowledgeable of, and strictly follow or exceed the requirements of OBC Section 5.11 Hot Surface Applications.

.3 Provide to the site kettles of adequate size to suit the Work requirements and to be operated by a trained and experience kettle operator.
  - Two (2) kettles are required;
    - one for the Type III asphalt, and
    - one for the SEBS asphalt.
    - Do not mix asphalts.
  - Kettles shall remain at grade, not being placed on roofs.
  - Kettles shall not be left unattended at any time while in use and/or hot.
  - Maintain secure fencing, minimum 6 foot high, fully around the kettles and all fuel tanks; fencing shall be kept closed.

.4 Provide engineered railings at roof edge(s).

.5 Hoisting or chuting of material to grade and disposal of same shall be coordinated to not encumber the site and the use of the building and grounds.

.6 Provide purpose-made plastic debris chutes as required, or approved hoisting equipment.

.7 Provide clean tarps to protect the building and grounds from damage, staining.

.8 As required, provide plywood coverings to windows and other building components at risk of damage in the course of the Work.

.9 Roofing crews shall have a minimum of two (2) asphalt thermometers (infra-red or submersible probe), in clean and undamaged condition.
  - Temperatures must be taken at the kettles and also at the roof.

.10 Roofing crew shall not leave hot asphalt saturated mops lying on the roof at the end of use.

Preparation – Mechanical, Plumbing, Electrical:

.1 Coordination:
  - Consult with the Owner and Consultant in regard to any mechanical or electrical service interruptions required in order to raise equipment or otherwise take equipment out of service.
    - Once a schedule is set for service interruptions, strictly adhere to same.
  - Ensure crew is aware of air intakes and that they coordinate to disable operation of the fans during periods of time when asphalt is being mopped proximate to intakes.
    - Allow to also cover the openings with the fans off to prevent passive contamination of air in the ducting.

- Be certain to coordinate removal of coverings before the Owner reinstates the fans to service.
- Review project Drawings denoting extent of Work required at the mechanical units.

.2 Provide all M&E sub-trade labour and materials to execute the modifications to the HVAC, ducting and other roof-top mounted equipment.

.3 Coordinate with the Owner to terminate any abandoned services.

.4 Drains:

- Make detailed examination of the drains to determine the proper sizes and conditions of the drains to suit the site conditions.
  - Advise the Consultant as to any requirements for interior access and Work.
  - Size drains to the pipe size and not simply to the reduced size of existing retrofit/insert drains if applicable.
- Prepare piping at the building interior to allow for mechanical coupling.

Preparation – Railings:

.1 Ideally railings will be custom made hot dipped galvanized and set onto Thaler (or equal) post bases and with Thaler (or equal) flanges and large diameter ballast guards. Many of the "stock" railings are certified for use even to the roof edge, but engineering review often casts considerable doubt on the proper rating of these railings for many applications.

.2 Thaler or equal post bases are subject to engineering review by this Consultant, not the supplier or roofer – some stock bases such as the ARS-115 have been found to need upgrades. The ARS-400 has been found to be satisfactory in most cases.

.3 Custom spun aluminum "stack flashings" are often required that extend beyond the base plates and Thaler makes these without issue - and it is expected that other suppliers also can fabricate required items.

.4 Custom ballast collars are required to fit the enlarged circumference of the larger spun aluminum stack flashing. These are needed to prevent the roof ballast from punching a hole through the vulnerable (thin) spun aluminum flashing.
As an alternative, in some cases where room is limited, or drainage issues exist, smaller stack flashings can be used but tapered plywood is needed all around and over the base plates,

.5 Coordinate for the placement of base plates and anchors to the deck.

Preparation – Gypsum on Metal Deck:

If metal decks apply to the scope of Work, the perimeter curbs (usually 2x4 or 2x6) should be fixed to a width of ½" plywood and not to gypsum board. Ideally the plywood would extend approximately 4" beyond the curb face. Increase plywood thickness if Type X gypsum is being used.

.1 At the full perimeter of the metal deck, and at most roof penetrations/curbs, install an 12" width of ½" thick plywood (or as otherwise shown on the Drawings) to support the perimeter curbs.

- Utilize plates and screws as per gypsum but using fasteners at 16" o.c. on both edges of the plywood, staggered.

.2 Place 18 gauge metal over any nominal openings found in the deck, or at any irregular transitions of nominal length at the junction of metal deck pans.

.3 Place gypsum sheathing neatly fitted and tightly butted, with long edges parallel to the flutes, and with board edges supported on the flutes

- Stagger the sheets in adjacent rows.
- Confirm current GP Fastener Patterns source for reference. Increase fasteners for higher wind exposures, roof edges, building corner, etc.

.4 Secure with FM-approved fasteners and plates, minimum 12 per sheet, set to catch ONLY the top flutes of the deck and using fasteners that will not project a minimum of 1" but not below the level of the bottom flutes.

- Make interior inspection to verify that there is not conduit in the flutes.
- Use additional fasteners and plates at sheet edges in the event of irregularities.
- Use 15 fasteners and plates per sheet for perimeter sheets.
- Utilize the "GP Fastener Patterns" guide supplied by Georgia Pacific for 12 per sheet and 15 per sheet layout.
    - This is found at page 11 of their 20 page brochure "DensDeck Roof Boards".
- Alternatively, if an alternative equal gypsum product has been approved, utilize same manufacturer layout guide.
- If acoustic deck is in use, ensure that a joint tape or other product is specified for the gypsum to prevent asphalt seepage.

.5 For gypsum placed atop perforated acoustical metal decks, provide a proposal to the Consultant as to a method to prevent asphalt seepage – such as by taping the joints or otherwise.

Preparation – Curbs, Perimeters, Sleepers, HSS Supports, Raised Roof Penetration Boxes, Skylights, Etc.:

.1 Vapour Retarder at Transitions:

- Execute work with procedures to ensure that vapour barrier transitions extend up behind walls in advance of installing wall cladding systems, and down perimeter walls, lapping over wall vapour barriers.
- Prime substrate and then extend vapour retarder membrane under and behind the woodwork of curbs/sleepers/etc. and projecting beyond same no less than 4" and otherwise as shown on the Drawings.
    - Tie-in V.B. to the perimeter walls in the most direct manner (shortest route) possible.
        - Extend membrane beneath under curbs, retaining the V.B. as close as possible to the building interior, and do not carry V.B. up and over curbs.
- Pressure roll with a manufacturer recommended roller (not a paint roller) in all case, full coverage, not just seams.

.2 Blocking:

.3 In the design of perimeter curbs, utilize time-tested and proven constructions. Avoid "innovative" cantilevers. Ensure that the curb design includes a vapour barrier at the deck level, beneath the curb, not extending up and over the curb. Ensure that the curb is insulated. Avoid HSS steel posts and/or heavy steel Z-shapes that create significant thermal bridging.

.4 Note that if repairs and maintenance to walls and windows require the use of swing stages, ensure that a plan is prepared to properly support same equipment relative to the curb design.

- Do not construct curbs until vapour barrier is installed behind and beneath same where shown on the Drawings and as noted above.
- Construct curbs generally as shown on the Drawings – to be modified only after review and approval by the Consultant if as-built conditions expose alternatives of advantage to the project.
- Curbs and plywood facings must be rigid and secure, neatly cut and fitted without gaps or twisting.
    - Bevel cut plywood and blocking where shown on the Drawings.
- Tops of parapets and copings shall be sloped in accordance with conditions shown on the Drawings.
- Immediately upon setting woodwork in place, roof-in all woodwork.
    - If necessary, provide full curb protection with weatherproof covers and fully protection also for all insulation in the curbs.
    - Simple polyethylene covers will NOT be accepted.
    - Do not use a polyethylene faced self-adhesive backed material if same product is adhered since it will prevent bonding of roofing set with hot asphalt.

.5 Expansion Joints:
Next applies only for modified bitumen where in an inverted system and ballast is in use.

- Raise expansion joints minimum 4" above the top of the ballast.
- Maintain the specified movement gap.
- Do NOT utilize the commonly seen detail of a down-turned membrane "U" in expansion joints. The "U" shape collects water but cannot be sealed – there is no practical way to lap and seal membranes in the tight U profile. Instead, use flexible metal to span the joint with an upturn on one side. With movement, the apex of the angle simply flexes to allow movement. The metal allows the self-adhesive backed membrane to be installed and pressure rolled to effectively adhere and seal the seams.
- Plan the profile to match one of the proven SMACNA metal expansion joint details for the prefinished steel finish flashings.
- Carry light gauge (e.g. 26 ga.) galvanized metal across expansion joints, secured such that it will flex if the joint opens/closes.
    - This shall include at deck level for continuity of the vapour barrier, and over the top of the joint to provide watertightness.
    - Pressure roll the membrane.
    - Fill the gap with Roxul or equal batt insulation.

.6 HSS Post Bases:

.7 Revise text to suit specific conditions at major mechanical supports, stair supports, railings, etc.

- Construct tapered blocking and sloped plywood bases to the HSS posts as shown on the Drawings.
- Ensure that all components are rigidly anchored and that all mitres are neatly fitted and tight.

Installation:

.1 General:

- Do not commence installation of new roofing until receipt of approval by the Consultant of all preparation work.
- Ensure all locations subject to asphalt penetration are sealed or taped.
- Ensure Owner has made ready all interior protections, relocations to guard against damage or injury due to unpredicted asphalt intrusions if applicable.

.2 Vapour Barrier:

- Heating of asphalt, equipment and tools, and installation of membrane, to be to applicable CRCA standards except where higher standards are set out in the Contract.
- Temperatures to be referenced are highly specific to the actual asphalt being used (supplier) and even more so to the Type of asphalt (i.e., Type II, Type III). EVT addresses the viscosity, measured in centipoise or cps, of the asphalt which varies by temperature. Note that the machine applied approach needs the higher temperature to feed through small holes, but same must be operated slower in order to achieve the same "thickness" of asphalt between plies. Specifying this correctly is key to providing a durable roof.
- Note that each supplier's asphalt, even for the same Type, will have varying application temperatures.
- Asphalt application (all membranes/materials):
    - Type III asphalt or the specified SEBS asphalt can be used.
        - Where SEBS asphalt is to be used, same must be from the membrane manufacturer.
        - Apply the IKO Easymelt 200 Type III asphalt within 17ºC (30ºF) of EVT.
            - This would be a base of 243ºC (470ºF) for application applied with a mini-mop.
            - For application by hand-mopping, use a reduced application temperature of approximately 224ºC (435ºF).
            - Temperatures noted are those at the moment the asphalt is placed on the roofing felts and not kettle of "lugger" temperature.
            - Roofer to be aware of and avoid approaching the Flash Point of the asphalt in use – 274ºC (525ºF) for EasyMelt 200.
            - If an alternative asphalt supplier has been approved, utilize same manufacturer's printed directions and as temperatures for that specific asphalt.

- If DensDeck or approved equal gypsum is in use, Consultant must review with GP as to current maximum asphalt temperature permitted and specify asphalt that complies.

- Ensure all surfaces are clean, sound and free of any loose material before proceeding.
- Ensure all substrates are dry before proceeding.
- Prime ALL substrates (all surfaces without exception and including all curb faces, all existing membranes to be lapped, etc.).
  - Use only the specified primer.
- Apply 1 ply #15 perforated felt vapour barrier of BUR.
  - Asphalt shall be to no less than 20 lbs. per 100 square feet and to no more than 25 lbs. per 100 square feet per ply.
  - If the base membrane is to be left overnight, or longer, it must be fully glaze coated with hot asphalt on the day it is installed.
  - If the Contractor elects to use this base membrane as temporary waterproofing, increase to 2-ply coverage but same shall be within the Contract Price.
- At perimeters, ensure that the specified transition vapour barrier membrane turns up at least 8" on curbs and otherwise as shown on the details.

.3 Insulation and Cover Boards:

- Place insulation and cover board in a process of staggered joints in each layer and relative to each overlying layer.
- Prime all substrates.
- Adhere all panels in full mopping of Type III asphalt, or with the specified SEBS asphalt.
- Utilize weights and heavy roller as needed to aid in ensuring full contact adhesion.
  - Only as necessary, score top face of panels to aid in achieving full contact to substrate.

.4 Drain Preparation:

- Ensure that the sumped areas have been prepared at drains.
  - Grind concrete around drains as needed to ensure that membrane flashed drains sit low.
- As applicable, provide full blocking support for drain flanges and soil stack flanges where same sit atop insulation and cover board.
- Drain flanges shall be primed both faces.

.5 Stack Flashing Preparation:

- Remove all or portions of the existing stack flashings.
- Bring to the attention of the Owner/Consultant any stack pipes found to be loose or broken.
- Wire brush or abrade any scale/rust and or bitumen or caulking to the exterior of the pipe as may affect a proper fit of the stack flashing.
- Base flanges shall be primed both faces.

Modified Bitumen Membrane Work Conditions:

.1 Ensure that only Soprema trained crew are used in execution of the Work.
- Crew must have proof of training by the manufacturer.

.2 Ensure that the crew has manufacturer approved seam and heavy rollers, and hot air welding tools as required.

2-Ply Membrane Installation

.1 Verify all preparation Work.

.2 The specifics of the modified bitumen membrane installation are not fully detailed below.
- Prepare surfaces and complete waterproofing Work in conformance with the manufacturer's printed requirements (and augmented by any project-specific requirements set out by the manufacturer's representative) and the Soprema "Roofers' Guide" – or equal literature from the approved membrane manufacturer.

.3 Advise the Consultant 3 working days in advance of commencing Work on the base sheet, and then again in advance of commencing Work on the cap sheet.

.4 Base Sheet
- Offset the Base Sheet from panel joints of the cover board.
- Heat and apply SEBS asphalt moppings in conformance with the manufacturer's specifications.
- Ensure that all membrane application achieves 100% coverage/adhesion.
- Ensure that up-stands are flashed fully in accordance with the manufacturer's current published installer manual using separate field and flashing sheets – do NOT simply extend field sheet at the up-stands.
- Ensure that manufacturer specified gussets are installed.
- All inside corners must be tight and without curls or voids.
- Utilize small and heavy rollers and hot air welding tools for membrane laps where applicable and as set out by the membrane manufacturer.

.5 Cap Sheet
- Execute cap sheet Work to manufacturer's standards and achieving 100% adhesion/coverage.
    - For membrane that will NOT be left exposed to view, mop 100% of the sheet.
    - For membrane that will be left exposed, roughly 80% of the sheet will be adhered with the specified SEBS asphalt and the remainder being as set out below.
        - End laps to be finished with "Colply Trowel Grade" adhesive as set out by Soprema to maintain quality of finished appearance where completed work is exposed.
        - Side laps to be heat welded with Soprema heat welding equipment to maintain quality of finished appearance where completed work is exposed.
        - For alternative approved products, utilize the manufacturer's end lap adhesive and hot air welding equipment at side laps.
- Ensure that all up-stands are flashed per the manufacturer's details using separate field and flashing sheets.

- Ensure that all degranulation is neat to lines.
- Ensure that the manufacturer's specified gussets are installed.
- All inside corners must be tight and without curls or voids.
- Utilize small and heavy rollers and hot air welding tools for membrane laps where applicable.
- Apply granules to SEBS bitumen bleed-out at seams where exposed to view in completed Work.

Copings, Curbs:

.1 Prime all contact surfaces, avoiding staining of exposed surfaces, and apply self-adhesive backed "Tie-in and Cover Flashing" membrane across the top of curbs and copings, etc., as shown on the Drawings.

- Tie-in and Cover Flashing membrane turns down the inside face of the curbs by a minimum of 4".
- Tie-in and Cover Flashing membrane turns down outside face of the curb no less than 2".
    - Refer to the Drawings for lapping further onto starter metal detailing if applicable.
- In all cases, use manufacturer recommended roller (not a paint roller) to pressure roll the membrane seams and full surface.

Patio Slabs:

.1 Place patio slabs to the layout as noted herein and as shown on the Drawings.

- Unless additional are shown on the Drawings, include no less than 2 slabs at tops and bottoms of ladders/stairs, and at doorways; include at least 4 slabs at roof hatches.
- Maintain 2" gaps between slabs for areas where walkways interrupt primary drainage paths.
- Neatly saw-cut slabs to clear mechanical and other equipment and curbs.
- Keep full and cut slabs ½" to 1" offset from curbs and equipment.
    - In no case shall slabs interfere with equipment or roofing flashings.

.2 Mitre cut slabs sitting on uneven bearing and subject to rocking.

The 1" extruded polystyrene (Roofmate or equal) pads are essential to protect the membrane. The prefinished metal edge covers protect the insulation edges from premature deterioration due to UV exposure.

.3 Set all slabs atop 24"x24" extruded, expanded, foamed Type 4 CAN / ULC-S701-97 / CAN / CGSB-51.20-M87 polystyrene pads (Roofmate or equal).

- Utilize with custom prefinished steel flashings extending minimum 6" under the slab (all 4 edges) and ¾" downturned hemmed edges.

Metal Flashing:

.1 New metal flashings to all areas of curbs and parapets at the perimeters and at all roof penetrations, and at all sleepers, shall be as shown on the Drawings and otherwise as reviewed with the Consultant.

.2 Verify that all curbs have proper/intended slope-to-drain.

.3 Contractor shall review with the Consultant all metal details and profiles before commencing fabrication.

- On site review and sketches or mock-ups shall be provided.
- Horizontal leg of the L-shaped edge flashing shall extend 3" under the ballast and also cover the gapped edge of the insulation (if applicable).
- Ensure that all metal flashings are placed over an underlayment of the "Tie-in and Cover Flashing" and as generally shown on the Drawings.
- Metal shall not be set onto exposed asphalt and felts.

.4 Ensure that all filter fabric is lifted to displace upward any ballast stone that has slipped into insulation gaps at the perimeter.

- Displace the ballast onto the roof so that the filter fabric is free of ballast and extends up the curbs before the L-shaped leg of the metal flashings are installed.

.5 Continuous cleats shall be used and shall be of the same metal and gauge as the overlaying flashings.

- Cleats shall be installed to level, straight lines and shall be shimmed as required to achieve same results.
- Proper anchorage of the cleats is key to the successful wind-tight installation of the metal flashings.

.6 All joints shall be professionally executed lock joints with fasteners set through hidden tabs.

.7 Allowance shall be made for expansion/contraction.

.8 At expansion joints, utilize a SMACNA approved detail if there is not a detail shown on the Drawings.

- Same detail shall be subject to submittal of a drawing/sketch or mock-up at a preliminary stage.

.9 All edges shall be hemmed.

.10 Standing seams should be used at mitred corners.

.11 Turn up ends of the metal flashings at walls.

- Extend minimum 4" up behind siding.
- Turn up and terminate in a reglet, and seal, for termination at masonry.

.12 Exposed fasteners shall be limited to those essential by the nature of the Work and/or where indicated on the Drawings.

- Include colour-mate screws at the inner coping edge for added wind restraint.

.13 Maintain separation of dissimilar metals by using separation sheet or by back-coating.

.14 Sealants are not to be used on metal flashing joints, apart from where indicated on the Drawings and as approved by the Consultant at the request of the Contractor.

.15 Anti-slip Protection:

- At wide curbs and/or expansion joints in walkways where foot traffic is reasonably expected, and as shown on the Drawings, neatly cut, test-fit, prime and pressure roll into place the self-adhesive backed anti-slip protection matts.

Sundry Mechanical Work:

.1 Complete sheet metal covers (inverted U-shaped protection) for all refrigerant set lines set atop the specified pipe support blocks.

.2 Supply and install all needed pipe, conduit and duct supports.

.3 Install any specified/designed "bridges" with steps and railings to enable safe service access over cable trays, pipes, ducts, etc.

Completion, Clean-up:

.1 Ensure that all temporarily removed/lifted equipment is put back in place with new stainless steel anchors to suit site conditions and left sealed and watertight.
.2 Ensure that all HVAC and other equipment have been put back in service and that all electrical work and service connection is complete.
.3 Verify that all drain fittings are installed and secure.
.4 If/as applicable, verify that all drain piping is properly installed, watertight and insulated and wrapped.
.5 All debris and removed equipment is to be removed and disposed of offsite.
.6 All surfaces are to be cleaned, fully, of bitumen and other stains resulting from the work.
.7 All drains are to be verified to be free flowing and unobstructed, complete.
.8 At grade, all remnants of the work shall be cleaned up, including all wind-blown insulation and other debris.
.9 Clear adjacent roofs and other surfaces of any debris from the work.
.10 Repair grade level landscaping by installing sod to any damaged grass areas affected by the Work.

Final Inspection:

.1 Verify that all Work is completed.
.2 Verify that all areas of the Work are clean and that no debris remains on site.
.3 Co-ordinate with the Consultant and Owner to conduct a final inspection.
.4 Provide completed OIRCA/CRCA warranties (roofing and sheet metal, etc.) to the Owner.
.5 Provide completed manufacturer extended warranty.
- Provide O&M manual to the Owner and meet with the Owner to set-out and explain to the Owner their requirements under the warranty.

07 62 00 Copper Flashings and Trim

Description of the Work:

.1 This Section pertains to shop and field fabricated copper metalwork including the following:
- 1.1.1.1 Step flashings at the sides and backs of chimneys and parapets.
- 1.1.1.2 Coping and wash stone cover flashings.
- 1.1.1.3 Gutters and downpipes.

Related Sections:

.1 04 03 42, Historic Replacement of Quarried Stone
.2 04 05 05, Selective Demolition for Masonry
.3 07 92 10, Sealants

Definition:

.4 Within the context of this Section, the term "copper" shall refer to copper and lead-coated copper.
- Specification for the use of each product is set out herein and on the Drawings.

Reference Standards:

.1 ASTM B101-02 – Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.
.2 ASTM B370-98 – Standard Specification for Copper Sheet and Strip for Building **Construction.**
.3 ASTM B32-00e1 – Standard Specification for Solder Metal
.4 CSA B111-1974 (R98) – Wire Nails, Spikes and Staples.
.5 "Copper in Architecture Handbook" (most recent edition) by Copper Development Association (CDA).
.6 "Architectural Sheet Metal Manual" (most recent edition) by SMACNA – this manual shall not supersede the CDA handbook or these specifications.
.7 Lead Sheet Technical Manuals (Lead Sheet Association – UK): Volume one: Lead Sheet Flashings, and, Volume Three: Lead Sheet Weatherings.
.8 Except where explicit directions are given in the contract documents, do all roofing Work in accordance with the SMACNA and CDA manuals noted above and using best practice options where options exist.

Qualifications:

.1 For Work including copper roofing and modified bitumen waterproofing, the Contractor must be a member of the OIRCA and/or the CRCA.
.2 The crew executing the copper flashing must be employees of the Contractor or of a sub-trade named in the formal tender submittal at the time of tendering.
.3 The full-time foreman and lead hand of the copperwork shall have no less than 5 years' full-time experience in copper flashing and/or copper roofing, or in the alternative, no less than 10 years verified experience in metal roofing, metal flashings, etc.
.4 Workers of this Section shall be fully knowledgeable and versed in the standards set out in SMACNA and CDA manuals noted above.

Warranty:

Flashings are not intended to be watertight, so flashing warranty should normally not apply to watertightness.

.1 Provide a 2-year written warranty that all work will remain sound and wind-tight.
.2 For copper roofing work, provide 2-year warranty on the OIRCA/CRCA form.

Environmental Requirements:

The following applies to the membrane underlayment beneath copper roofing.

.1 Conduct Work only during dry weather conditions and as set forth to be satisfactory to the membrane and roofing materials supplier.

Delivery, Storage and Handling:

.1 All products delivered to the site shall be as set out in the specifications or otherwise as explicitly approved in writing by the Consultant in advance of delivery to the site.
.2 All products shall be stored with labels in place.
- Weigh bills shall be provided upon delivery of products that do not have labels.

.3 Membrane rolls should be stored on end and covered by water repellent breathable covers.
- Membrane rolls must be maintained above any moisture that could impact the rolls including rain, snow and splash.

.4 Store adhesives and caulking in sealed, labeled containers and at temperatures above +5°C (41°F).
.5 All lumber products must be stored level and covered with breathable water repellant covers.

Protection:

.1 Maintain the building watertight during the course of this Work.
.2 All components of the Work are to be handled and installed to ensure against wind blow-off.

System Description:

Edit to clarify what material and weight is required for each location at which metal is to be used.

.1 The term "metal" or "copper" shall be interpreted as "lead-coated copper" in the base bid. Designations are as follows:
.2 Skirt Flashings, Step Flashings (along gable copings):
- Lead-coated copper

.3 Crickets to the roof behind chimneys:
- Lead-coated copper
- Lead-coated copper

.4 Gutters, Downpipes:
- Lead-coated copper
- Edit to clarify what material and weight is required for each location. Refer to period-suitable designs.

.5 Gutter brackets, gutter braces:
- ⅛" x 1" preformed, pre-drilled stainless steel

.6 Gutter reinforcing bar:
- ¼" thick, sized to fit gutter edge, pre-drilled. stainless steel

.7 Downpipe stand-offs:
- ⅛" x 1" preformed, pre-drilled stainless steel

Submittals:

.1 Schedule:
- Provide a schedule indicating site measurement, shop drawing submittal, fabrication and installation through to completion.

.2 Shop Drawings:

- Consultant to note that the Drawings, not the shop drawings, are to show required detailing for waterproofing if applicable.
- Provide shop drawings showing primary details for assembly.
  - Neatly presented hand sketches will be accepted but must contain all required information.
- Note that there are variations in standards and specific CDA and SMACNA details can be called-out on the Drawings to make clear which is intended by the Consultant.
- In order of priority, shop drawings are to adhere to the standards of the Drawings, the CDA manual, and the SMACNA manual.
- Indicate dimensions, slopes, up-turns, reglet details, drip edges, starter strips, etc.
- Identify underlayments.
- Identify fastening products, spacings, embedment depth, etc.
- Note that sealants are not normally a part of flashing work apart from isolated locations, wall flashings, and at reglets.
- Identify sealant locations and sealant types.
- Provide shop drawings for project specific detail conditions expected to present complex requirements.
- If a shop drawing is submitted showing a variation from the Contract requirements, same must be clearly highlighted as being a variation.
  - Failing to make clear variations will result in same variation not being deemed to be approved.
- At the discretion of the Consultant, a mock-up could be accepted in lieu of shop drawings.

.3 MSDS:

- Provide MSDS sheets on all products of the Work including primers, adhesives, solvents, cleaning products, etc.
- Submit duplicate clean copies of current data sheets and bind in 3-ring, Cerlox or similar folders.

Mock-Up:

.1 For conditions agreed to by the Consultant, a mock-up can be provided in lieu of shop drawings.

.2 The Contractor shall notify the Consultant when mock-ups are completed and ready for review.

- Allow a minimum of 3 days advance notice.
- Identify in writing any variations in the mock-up as could exist from the Contract documents.
  - Variations not identified in writing at that time will not result in acceptance of such variations (e.g., metal weight/gauge).
  - All variations will be subject to approval and review of potential impact on Contract cost.

.3 Mock-up shall include all underlayments, starters and drips, fasteners, reglets, etc., to form a complete assembly representing the intended end result.

.4 Provide a mock-up setting out the intended base and step flashing profiles, means of attachment, lapping, angles, reglets.
.5 Modify the mock-ups as directed by the Consultant if Work does not comply with the specifications.
.6 Do not commence Work until the Consultant has reviewed and provided written acceptance of mock-ups.

PRODUCTS

Sheet Metal Materials

.1 Note that if copper materials are to be used on site, and/or built into the building at elevations accessible from grade, Queen's Security is to be made aware of the Work in advance to ensure that added monitoring during the Work can be applied, if possible, and to address concerns regarding post-construction theft risk.
.2 Copper: To ASTM B370, temper H00 (cold-rolled, 1/8 hard temper).
- Note: If temper 060 (soft temper) is required for some limited components such as intricate details requiring special forming, secure Consultant's written approval in advance.
- Call out heavier, such as 20 oz., material for locations of greatest waterflows, heavy ice and snow loading, etc., including roof pans and some valleys. The use of 20 oz. material is also suited to locations where attachment of gutters is limited to wider spacing of rafters. The use of 16 oz. is normally well suited to typical gutters, downpipes and flashings.
- Weight: nominal 16 oz. weight (thickness of 0.56 mm, 0.022")
- Weight: nominal 20 oz. weight (thickness of 0.69 mm, 0.027")

.3 Lead-coated copper: To ASTM B101, temper H00 (cold-rolled, 1/8 hard temper).
- Weight: nominal 16 oz. weight (thickness of 0.56 mm, 0.022")
- Weight: nominal 20 oz. weight (thickness of 0.69 mm, 0.027")

Gutter Brackets:

The following are examples only.

.1 ⅛" x 1" bent stainless steel bar of length to suit the site conditions.
.2 Pre-drill and countersink 3 holes at the fascia.

Gutter braces:

The following are examples only.

.1 ⅛" x 1" bent stainless steel bar, length to suit the site conditions and as shown on the Drawings.
.2 Pre-drill and countersink 1 hole at fascia; drill 1 hole at reinforcing bar connection.

Gutter reinforcing bar:

The following are examples only.

.1 ⅛" stainless steel bar, height to suit gutter lip; or,
.2 ¼" copper bar, , height to suit gutter lip.
.3 Pre-drill approximately 5/16" holes at centres as required to align with gutter braces.

Fasteners at Gutters:

.1 For brackets: minimum #10x4" stainless steel (303)
.2 For reinforcing bar (gutter edge): Red brass or stainless steel (review with Consultant as to metal to be used) machine bolts with 1/4" thread, length to suit, and brass or stainless steel washers, stainless steel nuts.
- For copper gutters, the use of round head brass machine screws is preferred for aesthetic reasons.
- For lead-coated copper gutters, the use of round head stainless steel machine screws is preferred for aesthetic reasons.

Downspout stand-offs:
The following are examples only.

.1 ⅛" x 1½" stainless steel bent bar of lengths to suit (vary each location — allow average bar length of 12"), predrilled to suit.
.2 Fasteners at Downspouts:
- Stand-off to standing seam of downspout: 5/16" stainless steel round head machine bolts, of length to suit (~¾" to 1") complete with stainless steel washers (2 ea.) and nuts.
- Stand-off to wall: Powers Fasteners "Power Bolt" ¼"x3" stainless steel, or, Hilti "Kwik Bolt II Expansion Anchor 316SS" (¼" x 3¼"), or, approved equivalent.

Accessories
.1 Solder: 50-50 tin/lead solder with rosin flux
.2 Cleats, Starters:
- Of same material, and temper as sheet metal.
- Thickness same as sheet metal being secured.
- Minimum 2" wide.
- Continuous.

.3 Precast concrete splash pads:
- Approved Product: "21"x"10" by Planes Precast Concrete (Kingston), or equal wet cast product.
  - Do not utilize dry-cast products.

Fasteners:
.1 Sheet metal fastening to stone/masonry/concrete:
- Powers Fasteners "Zamac Nail-in" with stainless steel pins, ¼" x 1¼" or as approved by the Consultant and as needed to suit site conditions.

.2 Sheet metal fastening to wood substrates:

- Large-head copper slating nails, 10 gauge, ring barb or as otherwise approved by the Consultant.
- Length as required to penetrate no less than 2" into deep solid wood (such as timbers), or ½" through the underside of decking.

.3 For all other purposes for which fasteners are not identified:

- Use only stainless steel (303) and copper or brass fasteners as approved by the Consultant where not specified herein.
    - Note: No carbon steel nails (galvanized, coated or otherwise) and no cadmium plated fasteners are to be used.

Underlayment membrane (at curbs and flashings, valleys, copings, etc., but not as waterproofing):

"High temperature" grade underlayment membranes are generally NOT required and were developed for use under low emissivity, high absorption metals in climates like that of Arizona. Approved products below exceed ASTM required 70ºC for underlayments and can in fact reach 90ºC and higher. The HT grade products will test to perhaps 140ºC to 150ºC – but those requirements are not encountered here in 4-ply roofing applications. It is though not detrimental, other than excessive cost, to use HT grade alternatives. If, however, prolonged (greater than 90 day) direct exposures to the weather/UV is expected, then the HT products might be merited but must be approved in writing by the manufacturer on a case-by-case basis.

.1 Grace Construction Products "Ice & Water Shield", rubberized asphalt; or,

.2 Soprema "Sopraseal Stick 1100 T" (1.0 mm thick, polyethylene woven reinforcing and SBS modified bitumen) and primer as set out for "Sopraflash Stick" above.

- 2.9.2.1 Care must be taken to use the winter or summer grade product applicable to the Work conditions.

.3 Or approved equal by the Consultant.

Paper slip sheet (under all metal to be soldered):

.1 Red rosin-sized building paper shall be in place under all copper to be soldered (if any) and serving to limit the risk of bleed.

- Approved product: W.R. Meadows (SealTight) Red Rosin Paper, ~3 lb. weight per 100 sq.ft., or approved equal.

Waterproofing (beneath watertight/soldered copper pan roofing):

The following presumes applicability to limited areas of copper pan roofing and not entire copper roof systems – for which a more comprehensive waterproofing specification is essential.

Heed general concerns for the use of a torch (this specification does NOT involve torching), and as set out in the O.B.C. 5.11 of January 2015.

.1 2-ply modified bitumen waterproofing:

- Base sheet: Soprema "Sopraflash Flam Stick", 2.5 mm thick glass mat reinforced SBS, self-adhesive backed, flammable top face, or approved equal.

- Ensure that applicable winter (-10ºC to 10ºC) or summer (>10ºC) grade product is used.
- Primer: Elastocol Stick or as applicable to an approved equal base sheet.

- Cap sheet: Soprema "Sopraflash Stick 40", 2.5 mm thick glass mat reinforced SBS, Duo Selvedge Edge (50% self-adhesive backed, 50% flammable back face), sanded top face, or approved equal.
  - Do NOT use granulated cap sheet.
  - Primer: Elastocol Stick or as applicable to an approved equal base sheet.
  - Application limitations: ≥10ºC (50ºF)
    - Use Low temperature (L.T.) product for colder applications of ≥0ºC (32ºF).

.2 Colply Trowel Grade Adhesive, or Colply EF Adhesive, or approved equal products.

Sealants (to reglets):

.1 1-Component polyurethane per 07 92 10, Sealants.

Ice/Snow Melt System:

If applicable, call out cables, controllers, snow sensors, sensor extension cables, service conduit and breakers, etc. Britech is Toronto based and typically provides timely service/delivery. This can be referenced here fully, or as "Per Section 25 51 00, Integrated Automation Control of Facility Equipment".

.1 Britech System _____, or approved equal.

.2 _____

Fabrication – General:

.1 The following presumes applicability to limited areas of copper pan roofing and not entire copper roof systems – for which a standing seams or other roofing would be more applicable.

.2 Fabricate metal flashings and other sheet metal work in accordance with applicable CDA specifications and as indicated.

- Utilize CDA "Wide Loose-Lock Transverse Seams" for all pitched roofs (3:12 and greater) unless shown otherwise on the Drawings or specified otherwise herein.
- Utilize CDA "Flat Lock Seam, Soldered" for all roof pitches from "flat" to less than 3:12.
  - No copper pans are to be installed on actual flat or back-sloped roofs.

.3 Form flashing pieces in 8' maximum lengths except as approved otherwise by the Consultant.

.4 Hem ALL exposed edges on underside minimum 1/2".

.5 Mitre corners.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.7 Flat Seam Soldered Pans:

- Execute Work in general accordance with CDA Manual section 8.5 "Flat Seam Roofing".

- Form pans with ¾" folded-under hems on 2 edges, folded-over hems on the opposing 2 edges.
- Stagger transverse seams.
- Fabricate sheets so that seam laps shed water.
- Pre-tin sheet edges for 1½" back from hem edges, all edges on both sides in accordance with SMACNA "Flat Seam Roofs".
- Fabricate pans top make roof-to-wall (or parapet) junction in accordance with SMACNA "Flat Seam Roofs", Figure 6-3, detail 2 entitled "Junction Parapet Wall".
- Match historic profile. This could require a custom profile to match a crown moulding on the rake edge fascia.

.8 Gutters:

- Gutters to be fabricated to the profile and size shown on the Drawings and to have inner wall no less than ½" higher than the outer gutter lip.
  - Gutter profile to be [Style B] [Style D] [Style F] [Style G] [Style H] [Style J] [Style K]
  - Gutter width to be [5"] [6"] [7"].
  - Unless required for heritage reasons, and then only if it cannot be varied, do not use round downpipes – which inevitably freeze-up and split.

.9 Downpipes:

- Downpipes to be [4"x5"] [4"x4"] [3"x4"] [rectangular] [3"] [4"] [corrugated].
- Unless shown otherwise on the Drawings, provide 1" standing seam, fully locked, on the back of the downpipes.

EXECUTION

Preparation:

.1 Fire Watch Plan – pertaining to soldering (if any):

- Submit a "Fire Watch Plan" to the Consultant.
  - Set out numbers and types of fire extinguishers to be on site and their locations relative to the Work.
- Fire watch plan to set out the duration before the end of the working day during which time no further soldering will take place and inspections will be made by the Contractor for evidence of problems.
- Daily inspection record to comprise name of inspector, time of last use of torches, areas of work during the day and confirmation that inspection has been made before departing.

.2 Fire Alarm:

- Coordinate with the Owner to cover and/or disable monitoring of the fire alarm in select areas for brief durations if the Work will risk triggering false alarms.
  - The Contractor will be responsible for any false alarms arising from failing to keep doors and intakes closed/covered.
  - If a fire watch is required during periods of disabled alarms, Contractor shall be responsible for same.

.3 Hot Work Permit:

- Coordinate with Owner and Consultant as to potential requirement for Hot Work Permit (such as for soldering).
    - Note that this Section will NOT involve or permit the use of open flame torches for roofing/waterproofing.

Installation - General:

.1 In general, install sheet metal work in accordance with CDA, SMACNA and CRCA specifications as detailed – CRCA manual shall not supersede these or the other noted specifications.
.2 Use concealed fastenings except where approved before installation.
.3 Lock end joints.
.4 Install metal to prepared reglets true and level, and seal to form weathertight junction.
- Metal at reglets to have angled "vertical;" legs, back-sealed.

Flat Seam Soldered Roofing Pans:

.1 Verify that all waterproofing membrane is in place, neatly fitted at corners and undamaged.
.2 Place rosin paper over the full waterproofing for areas where soldering is to be executed.
.3 Set sheets with cleats per CDA Manual at 12" o.c. on long edges, 6" o.c. on short edges.
- Cleats to be secured with a pair of large head copper roofing nails and the cleat to fold over to cover nail heads.

.4 Fully solder seams.
.5 Install roof-to-wall junction detail as set out for Fabrication above at 2.14.6.6.

Step Flashings:

.1 Step flashings shall extend down behind gable parapets/copings as shown on the Drawings.
- 3Provide a drip edge to the base of the last step to direct water into the gutter and limit the wetting of walls directly under the gutter.

.2 For historic and practical reasons, flashings of individual overlapping steps are to be provided in lieu of lengthy pans with steps cut into them.
.3 Coordinate with Mason of Section 04 03 05, Masonry Procedures for Heritage Masonry, to chip off excess "pitch" of the stone faces.
.4 Prepare reglets minimum 1½" deep.
.5 Dry-fit steps to ensure snug fit, absent buckling, and with adequate side laps (minimum 3").
.6 Place underlayment membrane to the wall in areas that will be behind the copper and lapping the 4" to 5" high vertical legs of the step flashings of the shingle roofing.
.7 Secure copper step flashings into the reglets and at the hidden edges of the flashing with Zamac Nail-in pins or rolled lead wedges that will not be exposed in the final assembly.

Eaves/Rake Edge Drip Starter:

.1 Fabricate metal as set out on the Drawings.
.2 Eaves edge and rake edge drips will vary in profile – conform to approved shop drawings and/or mock-up.

.3 Eaves edge drip flashing to be fixed to base of roof slope with large head copper nails at 12" centres, and lapping over top of gutter brackets and inner gutter wall.
.4 Roof underlayment membrane must lap from roof deck onto the sloped leg of the eaves/rake drip flashings.

Base Flashings at Chimneys, etc.:

.1 The base flashings occur on horizontal lines above the flat roof flashings.
.2 Prepare reglets no less than 2" deep into the stonework.
.3 New base flashings shall have horizontal leg of 2" and vertical leg of no less than 4" with hemmed edges and shall overlap up-turned roof edge flashings.
.4 At vertical corners, use standing seam (vertical) joint to facilitate flashing removal during future roofing work.
.5 Set base flashings with wedges or other fixing that is not permanent to facilitate removal during future roof work.

Gable Copings:

.1 Place underlayment membrane over copings as shown on the Drawings.
.2 Form coping cover metal utilizing CDA "Wide Loose-Lock Transverse Seams" to facilitate movement without preventing thermal expansion and while improving watertightness.
.3 Install starter metal both sides.
- Leave one hemmed/hooked edge of the coping open to be closed after installation.

.4 Install coping metal with pins in the top of the pans, hidden under the locks, and free to move over the sheet length.
.5 Close the formed open hem on one side to ensure a wind-tight final installation.
- If specific locations merit added wind tight security, install a pair of self-tapping stainless steel screws through the roof-side hem and starter.
- If this is not deemed to be adequate to ensure warranty provisions and best practices, reduce transverse seams to 4' in lieu of 8' centres.

.6 Where shown on the Drawings, specified herein, or to match existing conditions, undertake sealants installation along the underside or the coping metal in accordance with Section 07 92 10, Sealants.

Valleys:

.1 Valleys between roofs of differing pitches, or valleys to larger roof areas are to have a centre raised V rising 1½" above the valley pans.
.2 Valleys shall be fabricated utilizing CDA "Wide Loose-Lock Transverse Seams" to facilitate movement without preventing thermal expansion and while improving watertightness.
.3 Valley sides shall extend no less than 12" from the centre of the valley – refer to Drawings.
.4 Install underlayment membrane to 30" of either side of the valley centre – creating a double thickness of membrane for approximately 6" either side of centre.

.5 Valley sides to be fixed with clips and pairs of copper nails, the clips folder over the nail heads, in the traditional manner.
.6 Valley base to hook over eaves edge starter-drip.
.7 Valley top to turn-up under ridge cap flashing as shown on the Drawings.
.8 Lap additional 6" width of underlayment membrane lapping from the initial 30" width of membrane onto the valley sides, covering the hemmed edge and cleats, but keeping back at least 2" from the exposed width of copper valley pan.
.9 Install or reinstate roofing as applicable laying to neat line, tapering with increased width toward the bottom as shown on the Drawings.

Watertight Copper Roofing:

.1 General:
- Execute the roofing in accordance with the CDA manual.
  - CDA "Wide Loose-Lock Transverse Seams" for all pitched roofs (3:12 and greater) unless shown otherwise on the Drawings or specified otherwise herein.
    - Steeper slopes but in areas prone to heavy ice and snow accumulation could required fully soldered pans – refer to the Drawings.
    - Utilize CDA "Flat Lock Seam, Soldered" for all roof pitches from "flat" to less than 3:12.
    - No copper pans are to be installed on actual flat or back-sloped roofs.
- Ensure that adequate slope of the roof deck has been prepared by others.

.2 Waterproofing (Membrane):
- Install 2-ply modified bitumen waterproofing in accordance with the manufacturer's current printed directions and as set out herein and on the Drawings.
- Preparation:
  - Ensure deck is dry.
  - Ensure that the deck is solidly nailed absent any popped or projecting fasteners, and absent raised edges of decking, broken/cracked planks, etc.
  - Examine the junction of the roof deck at all up-turns/walls and confirm that conditions offer a sharp corner transition, free of projections or gaps.
    - If gaps exist, install 22 gauge metal with 90º bend and secure to deck and wall.
      - This is essential to ensuring tight fit of membrane at the corners, and support for pressure rolling of the membrane laps.
  - Clean the deck of debris.
  - Prime the deck.
    - Allow primer to tack over as required by the membrane manufacturer.
    - Do not simply apply primer and follow immediately with membrane.

- Base Ply:
    - Install base ply starting at the bottom of the slope, lapping other roofing where applicable and in accordance with the Drawings.
    - Utilize good practice detailing usual for modified bitumen roofing and terminate field sheet at the base of the vertical sides.
    - Then flash with a separate sheet down the vertical and extending minimum of 4" onto the field sheet.
    - No voids will be accepted in the corners.
    - Pressure roll with an approved roller (not a paint roller) the full base membrane, not just seams.
        - This is an essential step.
    - Coordinate in advance with the Consultant to make review of the completed base sheet before proceeding with cap sheet Work.
- Cap Sheet:
    - Note that this is not a granulated sheet.
    - Verify that the membrane on site is temperature suitable to the job conditions.
    - Commence Work lapping the upper end of the lowest roll of base sheet by 50% to ensure offset transverse seams.
    - After removing the protective under-face film, pressure roll the self-adhesive backed 50% width of the sheet, fully.
    - The remaining 50% width of the under-face is to be sealed using a SOPRAMATIC automatic hot-air welder, or applicable alternative manufacturer equipment.
    - Because of the sanded top face, the field cap sheet shall be tightly fitted to corners and carried up the vertical face.
        - Voids will not be accepted in the corners.
        - If there is need to lap membrane beyond the selvedge edge, broom the parting sand in the affected area and use a notched trowel to apply a uniform thickness of approved trowel grade adhesive.
            - Adhesive pails must be maintained and installed when at building interior temperatures.

Sealants (to reglets):

.1 Per Section 07 92 10, Sealants.

Gutters, Downpipes:

.1 Pre-start Review:

- Make examination of roof eaves conditions to confirm soundness of fascias, rafter tails, edge of decking.
    - Make repairs to woodwork per Section 06 20 00, Finish Carpentry.
- Make site examination with the Consultant to confirm downpipe numbers and locations, potential relocation of building equipment, water loading expected per downpipe, downpipe terminations (to splash pads, to below grade where permitted, etc.), etc.

- Review gutter drainage plan with the Consultant as to directions of slopes, amount of slope, visibility of slope, etc.
- Review downpipe stand-offs with the Consultant as to offsets form walls, from string-courses, rounded versus angled elbows, grade level pipe extensions, etc.

.2 Gutters:

- Install gutter brackets to the fascia at the specified spacing, but no less than at every rafter tail.
    - Allow for 3 fasteners per bracket or as shown on the Drawings.
- Set brackets to create slope to drain as set out in pre-start review.
- Top of brackets to be fitted behind the drip edge starter at the base of the roof deck.
- Set gutter and verify slope to drain.
- Install gutter edge reinforcing and gutter braces.
    - The braces can be fitted up behind the eaves edge drip, or onto/through the gutter brackets – as shown on the Drawings and as agreed at the shop drawing and/or mock-up stage.
    - Secure gutter edge reinforcing with fasteners as specified and shown on the Drawings.
- Consultant is to provide the "A" through "E" dimensions shown on the CDA detail based on building dimensions and aesthetic preferences but not limiting thermal movements.
- Expansion joints in the gutters shall be as detailed in the CDA manual for "Butt Type Expansion Joint".

.3 Downpipes:

- Prepare nominally tapered gutter outlets with ½" wide flanges to fit in the gutter bottom.
- Neatly cut and fit, soldering flanges in place.
- Top elbows (2 or more) at each downpipe to be soldered together and soldered also to the top of the downpipe – but loosely fitted onto the tapered flange projecting from under the gutter.
- Downpipe to be secured with 1 stand-off per 10'.
- Bear in mind that an ice filled downpipe is a serious potential hazard if falling from place.
    - Variation from this can be reviewed with the Consultant to ensure best appearance and sufficient support.
- Place splash pads at grade where noted on the Drawings and specified herein.
- Ice/Snow Melt System:
- Install ice/snow melt system to the downpipes and gutters at locations as shown on the Drawings and specified herein.
- Call out applicable Section.
- Install in accordance with Section 25 51 00, Integrated Automation Control of Facility Equipment.

Clean-up, Completion

.1 Clean-up all materials, equipment, and debris.

.2 Clean gutters and downpipes of debris; verify proper drainage.

.3 Execute and deliver warranty documents.

07 92 10 Sealants

GENERAL

Description of the Work:

.1 Included shall be all sealants as detailed and specified, and as reasonably foreseeable by the nature of the Work.
.2 Quantities and not measured for payment and Work is based on lump sum.

Environmental Conditions:

.1 Sealants and substrates shall be a minimum of 5°C and a maximum of 30°C.
- Working in shaded conditions is recommended for all exterior joint sealants.

.2 No sealant shall be installed during damp/wet weather conditions.

Warranty:

.1 Contractor of this Section shall warrant the proper performance and durability of all sealants for a period of two (2) years against water entry, sagging, blistering, staining and failure of adhesion.

Quality Control:

.1 Mock-up:
- At the start of the Work, sample cleaning, priming and sealing shall be undertaken by the Contractor to the satisfaction of the Consultant.
- Approved standards shall set the minimum standard of the Work.

Submittals:

.1 Provide "wet samples" of sealant colours for selection.
.2 Provide MSDS sheets on all products of the work including primary roofing materials as well as primers, adhesives, solvents, cleaning products, etc.
- Submit duplicate clean copies of current data sheets and bind in 3-ring, Cerlox or similar folders.

PRODUCTS

Materials:

.1 While manufacturers will claim primerless adhesion, they will also admit improved adhesion is possible when using a primer. After many years of testing and assessment, including submerged sealant testing stages, the value of primer has been confirmed.
.2 Tremco and some other suppliers makes excellent products deemed as "equal" for each listed product below and submittals from the manufacturer, not from a construction supplier, should be welcome.
.3 Primer – The manufacturer's available primer shall be used even where primerless adhesion if promoted.

.4 Sealants: For new masonry, concrete and similar materials, 1-component polyurethane products are likely ideal but certain silicones also can provide excellent results. For silicones especially, do not specify custom colours due to exorbitant costs.
- For new exterior masonry/concrete joints:
  - Dow DC 790, or approved equal.
  - Colour to be selected by the Consultant from the manufacturer's standard range.
- For aged masonry, concrete and similar materials, 1-component polyurethane products are recommended. Utilize multi-component products only on large "production" jobs where the care needed in mixing can better be assured by the nature of the project.
- For exterior masonry joints exposed to minimal joint movement (25% or less of joint width):
  - Sikaflex 1A, Tremco Dymonic, or approved equal.
  - Colour to be selected by the Consultant from the manufacturer's standard range.
- For exterior masonry joints exposed to increased joint movement (more than 25% to 50% of joint width):
  - Colour to be selected by the Consultant from the manufacturer's standard range.
- For masonry joints expecting movement in excess of 50%, joints should be redesigned to reduce movement or to incorporate covers to protect the joints.
- For metal-to-metal and metal-to-glass joints:
  - Dow DC795, or approved equal.
  - Colour to be selected by the Consultant from the manufacturer's standard range.
- For horizontal joints:
  - Only use for protected and/or covered joints and not in areas of direct traffic.
  - Sikaflex-2C SL self-levelling multi-component polyurethane, or approved equal.

.5 Cleaners - Cleaners shall be used and shall be as recommended by the sealant manufacturer and as approved by the Consultant.

.6 Joint Filler / Backer Rod:
- Outsized minimum 30% and preferably 50%.
- Polyethylene, extruded closed cell foam.
  - Note that SoftRod and polyurethane will not be accepted.

.7 Masking Tape.

Design:

.1 Note that commonly referred to joint profiles of 2:1 are often excessively "thick" and "stiff" and limit joint movement while being prone to adhesion failure. Joint profiles of 8:1 and 12:1 are sometimes used in primary building expansion joints where self-levelling silicones are used, and the joints are covered to protect them from physical abuse.

.2 For movement joints, joint profiles of 3:1 are preferred for polyurethane and up to 4:1 for silicone is usually ideal to ensure excellent joint movement and minimal stress on the sealant.
.3 A mid-joint depth of ¼" is desired.
.4 A depth of joint of ½" at the joint faces is desired.

EXECUTION

Pre-Start:

.1 Testing:

- If the Consultant desires testing, it should include:
- The test procedure can be expected to leave staining so the substrate being tested should either be a disposable sample, or in a location that will not be visible upon completion.
- A 7-day to 10-day dry-cure test should be undertaken with no less than 4 of each sealant product being tested.
- Samples should be 1" wide and 6" long and have embedded screen to assist in the pull test.
- Samples should be applied to dry substrate products matching the target substrate.
- Samples should be placed after cleaning and priming to match intended field application.
- 50% of the samples should be pulled at the end of the test period.
- Then the remaining sealant products that showed good dry-cure results should be fully submerged in water for 3 days and then re-tested.
    - A 3-day non-stop gentle "lawn sprinkler" application of water onto a test panel is also satisfactory where it is the most practical means of testing subject substrates.
- Only sealants showing excellent adhesion after the water submerged period should be considered for use.
- Make assessment of any staining resulting from the primer application.

.2 Conduct a pre-start meeting with the General Contractor and Consultant to review proposed coordination to ensure safe conduct of the Work, staging and scheduling.
.3 Provide mock-ups of the sealant Work.

- Coordinate for review by the Consultant in advance of commencing Work.
- Mock-up all primary sealant joint profiles/types.
- Consultant will observe cleaning, backer rod placement, and priming and tooling.
- Undertake adequate size of samples to ensure subsequent ability to properly assess the depth of the sealant at the mid-section and at the bon interfaces.
    - The follow-up assessment is likely not feasible until 5-7 days have passed for substantial curing – scheduling should accommodate this delay.
- Consultant will confirm the sealant colour at this stage.
- Approved sample colour, joint preparation and profile will form the basis for approval of the field work.

Project Preparation:

.1 Adhere to all Ministry of Labour requirements for the Work.
.2 Where applicable, provide swing stages installed by certified installers and operated by trained operators.
.3 Where elevated working platforms are to be used, coordinate with the Owner and Consultant as to areas of underground services and load limitations.
.4 All Workers to have applicable Working at Heights, WHMIS, and other safety training.
.5 Workers to review the project Designated Substance Report in advance of conducting Work.
.6 Workers to review posted diagram and instructions for the use of existing roof and wall mounted life safety anchors, life lines and other static safety equipment.

Removal of old sealants:

.1 Remove any existing sealants in accordance with the Designated Substance Report.
- Post warning signs and place barriers as required by the Ministry of Labour and other agencies having authority.
- Contain removed sealants and remove daily for disposal by required methods and licenced parties.

.2 Clean joints neatly of all residue of the original sealant.
- Utilize knives, oscillating bladed tools, manufacturer recommended cleaners, etc.
- Avoid the use of grinders and use only as approved by the Consultant.
  - Include all required safety and clean-up tasking as results.

Preparation for Installation:

.1 Examine joints, joint conditions, access requirements.
.2 Upon confirmation that all removal and cleaning is complete, notify the Consultant to arrange for confirmation inspection.
.3 For self-levelling sealant placement, ensure that joints are closed off to prevent sealant entry to the building or equipment.
.4 Upon satisfactory sign-off by the Consultant, install new backer rod and/or joint backing bond breaker tape if/as required.
- Verify that the backer rod is correctly sized.
  - Do not twist lengths of backer rod together.
- Utilize a tool to ensure that the backer rod is set at the depth needed to achieve the desired joint profile.
- Do not push the backer into place in a manner that creates holes in the face of the backer rod as same can lead to blisters in the sealant.

.5 Where necessary to prevent staining and/or as necessary to ensure straight sealed joints, apply masking tape to the joint sides prior to priming and sealing.
- Note that primers can in some cases leave a residual staining and this should be assessed/tested in advance.

.6 Undertake priming according to the techniques specified by the sealant manufacturer.
.7 Advise the Consultant in advance of placing sealant so that initial sealant application Work can be observed.

Installation:

.1 Generally, install sealant to a minimum centre of joint thickness of 6 mm (¼").

.2 For typical recessed joints, maintain the depth of the joint at the surfaces (i.e., at the sides of the joints) at 12 mm (½") and create a joint width to joint depth (at centre of joint) ratio of 3:1 to greater.
.3 Do not apply sealant onto the "face" of the wall, or create fillet beads in corners, but instead use recessed or back-sealed joints.
.4 Apply sealant with sufficient pressure to fill the joint and using the proper nozzle size.
.5 All joints shall be tooled separate from the sealant application.

- Workers applying sealant without tooling shall be removed from the job site as tooling is essential to the proper "wetting" of the joint faces.
- Use a wooden or other tool.
- Tooling must press sealant against the joints sides to fully "wet" the surfaces and must not displace the backer rod or tape.
- Form the surface of the sealant to the specified profile and as necessary to achieve the required joint geometry.

Clean-up:

.1 Remove masking and clean all surfaces as required.
.2 Clean-up all stains, drips, smears.
.3 Allow to return within 1 week to cut and repair any blisters that could form.

- Cut-out shall be a scalloped hole cut in the centre of the affected joint, generally not affecting the joints sides.

Final Inspection:

.1 Verify that all Work is completed.
.2 Verify that all areas of the Work are clean and that no debris remains on site.
.3 Co-ordinate with the Consultant and Owner to conduct a final inspection.
.4 Prepare and provide written warranty to the Owner.