APPENDIX G
07/01/10

DEB ROOFING POLICY & TECHNICAL STANDARDS FOR STATE-OWNED BUILDINGS

G.0 GENERAL

The Appropriations Act requires that all agencies requesting general funds shall assign first priority to the roofs of their facilities. The provisions of this Appendix shall govern the design of low-slope, flexible membrane (built-up and single-ply) roofs. This Appendix also governs the design of metal roofing systems to be used on state-owned buildings.

This Appendix provides criteria and qualifications for selecting full- time Roof Inspectors (Section G.21) and Roof Consultants/Inspection Services Providers (Section G.22). It also provides criteria for non-destructive evaluation (NDE) roofing surveys and criteria for drawings to accompany NDE surveys (Section G.23).

New or reroofing project working drawings and specifications shall be prepared by a licensed Virginia Architect or Engineer. Procurement of these professional services is covered in Chapter 4 of 2004 Construction and Professional Services manual.

Assuming roofs are equal in other respects, low-slope roofs that shed water are more desirable than flat roofs that do not; and steep roofs are more desirable than low-slope roofs. Economy, aesthetics, constructability and compatibility are valid considerations in evaluation and design of roof systems. This Appendix provides not only mandatory provisions but sound advice on improving the survival rate of low-slope roofs.

G.1 ROOFING ABBREVIATIONS

AIA: American Institute of Architects
BUR: Built-up Roofing
BURSI: The Better Understanding of Roofing Systems Institute
CSI: Construction Specifications Institute
CSPE: Chlorosulfonated Polyethylene
EPDM: Ethylene Propylene Diene Monomer
FM: Factory Mutual
FSM: Flexible Sheet Membrane
KEE: Ketone Ethylene Ester
MB: Modified Bitumen
NDE: Non-Destructive Evaluation
NBP: Acrylonitrile Butadiene Polymer
NRCA: National Roofing Contractors Association
NRCA Manual: The NRCA Roofing and Waterproofing Manual (latest edition)
PVC: Polyvinyl Chloride
RCI, Inc: RCI, Incorporated (formerly Roof Consultants Institute)
RIEI: Roofing Industry Educational Institute (Now part of NRCA)
SPM: Single-ply Membrane
SPRI: Single-ply Roofing Institute
TPO: Thermoplastic Polyolefin
UL: Underwriters Laboratories

G.2 ACCEPTABLE LOW SLOPE ROOFING MEMBRANES

The following types of membrane are acceptable on low-slope roofs for state-owned facilities:

1. EPDM, Single-ply, 45 mil minimum thickness; 60 mil preferred.
2. KEE, Single-ply, 45 mil min. thickness
3. NBP, Single-ply, 45 mil min. thickness
4. PVC, Single-ply, ASTM D 4434 Type III and Type IV, 45 mil minimum thickness
5. TPO, 60 mil minimum thickness
6. Built-up Roofing, applied with Hot Bitumen, 4 ply minimum.
7. Hybrid 4-ply system (3-Ply BUR with reinforced Modified Bitumen cap sheet)
8. The Director of BCOM will consider the use of membranes other than those listed above only if the Owner requests and the A/E supports, in writing, the use of the alternative system. The request must be received and approved before working drawings are submitted for review and shall provide the following:
   a. The reasons for using other membranes
   b. A description of the system(s) and membrane(s)
   c. A summary of evaluated design criteria (See Section G.16 System Evaluation)
   d. ICC-ES Evaluation Report if system is not listed in the VUSBC
   e Confirmation from the A/E in writing that the roofing membranes and systems have been investigated and are suitable for use on the proposed project roof(s).
   f. Additional information as requested

G.3 OTHER LOW SLOPE ROOFING MEMBRANES

These include Vegetative Roofs and Plaza Decks

G.3.1 Vegetative Roofs

The roofing membranes shall be as indicated in Section G.2 ACCEPTABLE LOW SLOPE ROOFING MEMBRANES

Design of the Vegetative Roof shall use FM Data Sheet 1-35 Criteria (Wind load design criteria shall be in accordance with ASCE 7 instead of 1-35 criteria). The 1-35 Criteria Data Sheet is available for download at http://www.roofnav.com and includes information concerning

.

1. Non-Vegetated Border Zones
   a. Shall be per FM 1-35 requirements at Perimeters and corners
   b. Shall be a minimum 1.5’ wide at penetrations
   c. Shall be a minimum 3’ wide at machine rooms, penthouses, and walls
   d. Shall be a minimum 3’ wide to partition the roof area, not exceeding 15,625 square feet and 125’ in length
2. Parapet walls.
   a. Shall be a minimum of 6” above ballast or pavers for roofs below 150’ in height..
   b. Shall be a minimum of 30” in height for roofs 150’ or above in height and shall have a 3’ wide non vegetative zone.
3. Grade level roofs
   a. Shall have special load requirements
   b. Shall have a 3’ vegetation free break

G.3.2 Plaza Decks

Plaza decks, when constructed over occupied spaces, are considered to be roofs and shall use roofing membranes as indicated in Section G.2 ACCEPTABLE LOW SLOPE ROOFING MEMBRANES.

G.4 METAL ROOFING

The following types of metal roofs are acceptable on state-owned facilities:

1. Double lock seam or flat seam terne metal, copper, zinc or stainless steel roofs are acceptable when they comply with the latest editions of SMACNA Architectural Sheet Metal Manual, or the NCRA Metal Roofing Manual. Copper roofs shall also comply with the latest edition of the Copper & Common Sense Manual.
2. Lapped rib panels with exposed fasteners are acceptable only for utility structures such as sheds or pre-engineered buildings where the manufacturer is responsible for water tightness.
3. Architectural systems installed over a solid deck are acceptable for roof slopes 4:12 or greater, if they use clip-on caps or single lock ribs.
4. Structural systems, which can span between widely spaced purlins, may be used for low-slope roofs and must have machine-locked ribs a minimum of 2" high, with tape or gaskets between ribs.
5. Systems other than those described above must be approved by BCOM for use at the preliminary review stage. A/E shall submit product data on the system used as the basis of design and show that at least 2 other manufacturers make comparable systems.

If panels are longer than 10', details and specifications must show where the system is anchored (ridge, center, or eave) and how expansion is accommodated. Gaskets or tape shall be used to make seams watertight. Metal closures shall be provided at ends of ribbed panels.

G.5 ROOF SURVEY FOR REROOFING

Before reroofing a facility or making major repairs, the Owner must procure a roof survey performed by an experienced and qualified inspection service. See qualifications for a roof consultant/inspection services provider in Section G.22. The roof survey shall use non destructive evaluation (NDE) moisture detection methods indicated in Section G.23. For roof repairs or replacement where asbestos materials may be present, an asbestos survey shall be performed and the findings reported in writing.

G.5.1 Exception

For roofs that are very small or that have reached an advanced stage of deterioration and where a roof survey does not appear cost effective, an Agency may request a waiver of the roof condition survey after determining the conditions by visual inspection. The request must be accompanied by a roof plan sketch with features noted, a written description of the problems cross referenced to the plan, an approximate area of the roof, and photographs showing the conditions which support the request. An asbestos assessment is required.

G.6 REROOFING REQUIREMENTS

If complete reroofing is required for over 25% of the roof area in a calendar year:

1. Provide secondary (emergency) roof drains in accord with the requirements for new construction.
2. Provide guarantees for new construction
3. Provide insulation in the roof covering assembly in accord with the requirements for new construction.

G.7 OWNER'S ROOFING INSPECTION

The Owner shall have a full-time inspector on site while the roof is being applied. The inspector may be the project inspector or someone qualified to inspect a roof installation. See qualifications for a roof inspector and roof consultant in Sections G.21 and G.22.

G.7.1 Daily Report

The roofing inspector shall check all materials and application procedures and prepare a daily written report covering such items as: the weather conditions, the deck conditions, the materials stored, the materials installed, and the installation procedures used (including bitumen temperature at kettle and point of applications, etc.). A copy of the daily report shall be given to the contractor, A/E, and the owner. The inspector shall not permit installation of roofing materials without having first obtained from the design architect a copy of the approved shop drawings showing the ASTM's or other standards.

G.7.2 Semi-Annual Owner Inspections

The Owner shall inspect the roof(s) semi-annually, as a condition of the roofing guarantee. The Owner shall also inspect the roof(s) before the two-year guarantee expires. See additional requirements later in Appendix G.

G.8 PREBID CONFERENCE

If specified, the roofing bidders shall not be required to attend. They may question or comment on the specified roofing system, materials, details, and any other details thought to affect the roof. Response to comments shall be in writing by addendum if bid documents need changing.

G.9 PREROOFING CONFERENCE

A preroofing conference is required and shall be specified and held before ordering roofing materials.

1. Representatives of the owner (including the roofing inspector), architect, general contractor, roofing contractor, deck contractor, mechanical contractor, and roofing manufacturer shall attend.
2. Review of plans, specifications, flashing details, work scheduling, and workmanship standards is required. Problems and discrepancies shall be resolved.
3. A written record of proceedings shall be prepared and made part of the job record.

G.10 GUARANTEES

Specify guarantees and warranties for new construction or reroofing in the Special Conditions or General Requirements.

G.10.1 Roofing Contractor's Guarantee

Provide the following roofing contractor's guarantee on the General Contractor Guarantee:

The roofing contractor shall guarantee materials and workmanship associated with the roofing, flashings, and sheet metal work incidental to the work required under the roofing subcontract, against defect due to faulty materials or workmanship for a period of two (2) years from the date of Final Completion of the entire Project. It is understood and agreed by all parties hereto that the responsibility of the roofing contractor under this guarantee form or any contract document, shall be in accordance with the roofing contractor's limited guarantee.

G.10.2 Owner's Agreement

Provide the following Owners Agreement on the Contractor Guarantee:

The undersigned named Owner for the Commonwealth, agrees, from the date of Final Completion of the entire Project, to maintain the roof in accordance with the manufacturer's written requirements and also agrees to avoid damage to the roof surface by any parties under his control working or walking on the roof. The Owner recognizes his responsibility to inspect the roof semi-annually.

G.10.3 Contractor's Guarantee for New Construction

The (General) Contractor shall furnish, as a minimum, a manufacturer's 20-year total system material and labor warranty / guarantee with no monetary limitations (NDL no dollar limit) from the date of Final Completion of the entire Project. The contractor shall provide a workmanship warranty agreeing to maintain the entire roof system(s) in a completely watertight condition at no cost to the Owner for two (2) years from date of Final Completion of the entire Project. Sheet metal flashing incidental to the roofing shall be covered under the Manufacturer's Warranty.

Exception: Roofs less than 5,000 SF in area and roofs on utility or unoccupied structures shall have a minimum 10-year total system warranty.

G.10.4 Contractor's Guarantee for Reroofing

The (General) Contractor shall furnish, as a minimum, a manufacturer's 20-year total system material and labor warranty / guarantee with no monetary limitations (NDL no dollar limit). The contractor shall provide a workmanship warranty agreeing to maintain the entire roof system(s) in a completely watertight condition at no cost to the Owner for two (2) years from date of final acceptance. Sheet metal flashing incidental to the roofing shall be covered under the Manufacturer's Warranty.

Exception: Roofs less than 5,000 SF in area and roofs on utility or unoccupied structures shall have a minimum 10-year total system warranty.

G.11 PROCUREMENT OF ROOFING CONSULTANTS

If the Agency does not wish to procure roofing consultants under a separate contract, the Department of General Services offers state-wide term contracts for Roofing project inspectors and roofing consultants offering testing services. Agencies can follow the "Engineering and Building Contracts" link on the DGS website: http://dgs.virginia.gov. The specific contract is: "Non-Professional Construction Related Services."

G.12 ROOFING CONFERENCES

A prebid conference is not required but is strongly recommended for reroofing or roofing repair projects. A pre-roofing conference is required and shall be specified.

G.13 NRCA ROOFING AND WATERPROOFING MANUAL

Use the latest edition of the NRCA Manual as a guide in preparing plans and specifications for all new roofing projects and for reroofing projects to the extent practicable unless:

1. The NCRA Manual conflicts with provisions of this document, or
2. The A/E obtains approval from BCOM to use different details and provisions.

G.14 BIDDING ROOFING SYSTEMS

Specifications shall include bids for only one type of roofing system. For the purpose of bidding KEE, NPB, PVC and TPO shall be considered one roofing system. Single and multi ply roofing systems shall not be bid as alternates.

G.15 MATERIALS CERTIFICATION

1. Specify that the Contractor shall give to the A/E the roofing manufacturers certification that the roofing materials being furnished comply with specified ASTM and approved standards.
2. The owner's full-time roof inspector shall verify the materials received are as specified and in accordance with A/E approved shop drawings before roofing materials may be installed.

G.16 SYSTEM EVALUATION

The A/E responsible for roofing design shall evaluate and specify the roofing system(s) for:

1. Fire Resistance Rating
2. Wind Uplift Resistance (including roof system and sheet metal flashing components)
3. Warranty
4. Tear Resistance
5. Attachment
6. Resistance to harmful local chemicals
7. Membrane compatibility with insulation
8. Type of membrane seams and joints

G.17 SINGLE-PLY MEMBRANE (SPM) SPECIFICATIONS

1. Specify SPM completely with latest listed ASTM and performance criteria.
2. SPM, if specified with either manufacturer or brand-name products, shall be specified with three manufacturers and three equivalent products.
3. Use the latest edition of Roofing Materials Guide, published by National Roofing Contractors Association, to determine equivalent SPM.
4. The single-ply membrane manufacturer's representative shall check installation procedures at start-up and inspect the completed membrane installation before ballast is applied.

G.18 BUILT-UP ROOFING (BUR) MEMBRANE SPECIFICATIONS

1. Specify BUR and each BUR system component with latest available ASTM standards.
2. Specify, minimally, a built-up four-ply hot bitumen system.
3. Hybrid four ply systems shall have a reinforced Modified Bitumen cap sheet at least 120 mils thick with a mineral granule surface applied with hot asphalt over a three ply (minimum) hot bitumen system.
4. If manufacturers are specified, specify three manufacturers and three systems.
5. Specify Equiviscous temperature (EVT) range for bitumen application.

G.19 GENERAL REQUIREMENTS

The following requirements are generally applicable to all low-slope roofs. They shall be specified as indicated unless waived by the BCOM for justifiable reasons:

G19.1 Roof Slope

1. Specify that all roofs shall slope 1/4" per foot, minimum, to drains on all new roofs.
2. If a 1/4" slope is impractical on replacement roofs, the Owner may request authority to use a lesser slope from the Director of the DEB.
3. Dead level valleys are unacceptable. Valleys shall slope a minimum of 1/8" per foot unless impractical. In such case a waiver may be requested by the Agency to allow a slope of 1/16" per foot.

G.19.2 Wind Uplift

Roof assemblies shall be designed to resist the uplift loads as calculated using the current VUSBC edition of ASCE 7 for field, perimeter and corner conditions.

For additional information on wind design see the following:

1. Factory Mutual (FM) P7825
2. Factory Mutual (FM) Technical Advisory Bulletin 1-29.
3. Factory Mutual (FM) Loss Prevention Data Sheets 1-7 and 1-28S
4. Single-ply Roofing Institutes (SPRI) SPRI RP-4 Wind Design Guide

G.19.3 Insulation
Unless otherwise required to comply with a Manufacturers roofing system, specify insulation as follows:

1. C or R (per inch) factor
2. 2 layers, if thickness permits
3. Staggered joints
4. Mechanically fasten the first layer to metal deck. Cold applied adhesives and/or low rise foam products are acceptable for the attachment of the first layer to concrete decks, and for attachment of the individual insulation layers to each other contingent upon meeting FM I-90 wind uplift rating and the specified roofing material manufacturer's warranty.
5. Compatible Insulation: The A/E shall assure the Owner that the specified type of insulation has been investigated and is entirely compatible with contiguous, specified roofing materials.

G.19.4 Rooftop Equipment

1. Avoid if possible.
2. Comply with NRCA Manual recommendations.
3. Design clearances and details for easy re-roofing.
4. Provide prefabricated walks to and around equipment that requires servicing; walks must not block roof drainage.

G.19.5 Approved Applicator
Specify that the roofing and base flashing applicator shall be approved by the materials manufacturer.

G.19.6 Roof Protection
All specifications must state that before moving equipment or materials over a roof, the Owner, General Contractor, Roofing Contractor, and any of their agents must protect the roof from damage during and following roofing work. Movement of equipment and materials without roof protection shall be cause for the Owner, General Contractor, Roofing Contractor or A/E to stop work until protection is provided and any damage is corrected. The Owner's roofing inspector shall record all such violations.

G.19.7 Pre-Final Inspection Survey
Unless the Owner requests in writing a waiver of the survey for justifiable reasons and the Director of the BCOM approves the waiver, specifications shall include the following survey provisions:

1. The A/E shall notify the Owner, Contractor, and Roofing Contractor (in writing) that he has inspected the roof(s) and finds it (them) sufficiently complete to permit a roofing survey. In no case shall the survey be made earlier than forty days before the Substantial Completion Inspection.
2. The Owner shall engage the services of an experienced, independent roof survey inspection service or laboratory to survey the roof(s). The service shall use infrared, nuclear moisture detection, or electronic leak detection methods. Roof probes or cuts shall not void the Contractor's two year guarantee and the Manufacturer's warranty/guarantee.
3. The Roofing Contractor shall cooperate and assist the inspection service by making and repairing any required cores, test cuts, or probes in such a way that Manufacturer's and Contractor's warranty/guarantees are not voided.
4. A copy of the survey report shall be delivered to the BCOM no later than ten days before the Substantial Completion Inspection. Also, copies of all survey reports shall be delivered to the Owner, A/E, Contractor, and Roofing Contractor.
5. The Owner shall pay for the service unless the survey shows roofing deficiencies caused by improper materials, poor workmanship, or Contractor negligence. In that case the Contractor, at his expense, shall repair or replace the roof(s) and provide additional surveys until the

roofing work complies with the contract documents. All corrective work shall be completed before the final inspection.

6. Acceptance of the roofing system shall be contingent on a roofing survey report that indicates the presence of no detrimental amount of moisture; for example, moisture that would cause a significant lowering of the thermal resistance of the roof; separation of the roofing plies; blisters; etc.
7. Insulation that has lost more than 20% of its dry thermal resistance (R-value) and any materials covering the insulation shall be replaced by the Contractor at no cost to the Owner.

G.19.8 Final Inspection

The following items must be given to the Owner's representative at the Final Inspection:

1. A copy of the (general) contractor's and roofing contractor's two-year guarantee.
2. A copy of the roofing manufacturer's standard warranty/guarantee.
3. Copies of the History of Roofing Installation, Sample Form A; Roof Information Worksheet - Built-Up Roofing, Sample Form B; or Roof Information Worksheet - Single Membrane Roofing, Sample Form E. The A/E shall obtain forms from the Owner and complete all applicable items. (See Section G.24)

Representatives of the Owner (and the A/E), the Contractor, the Roofing Subcontractor, and the Membrane Manufacturer shall inspect the roof(s) between nine months and one year before the closing of the General Contractors one year guarantee. The Owner shall also have the roof inspected at least three months before the two year guarantee expires and notify the Contractor in writing of any defects noted. The Owner shall require that any defects be corrected at least 30 days prior to expiration of the guarantee.

G.20 METAL ROOFING POLICY

These provisions shall govern the design of all metal roofs (low slope or steep slope). See Section G.4 for Metal Roofing Systems.

G.20.1 Document prepared by A/E, Metal Roofing

New or reroofing project working drawings and specifications shall be prepared by an architect or engineer appropriately registered by the Department of Commerce, Commonwealth of Virginia.

G.20.2 Roofing Conferences, Metal Roofing

A prebid conference is not required but is strongly recommended for reroofing or roofing repair projects. A pre-roofing conference is required and shall be specified.

G.20.3 Guarantees, Metal Roofing

Specify guarantees and warranties for new construction or reroofing in the Special Conditions or General Requirements as follows:

G.20.3.1 Roofing Contractor's Guarantee, Metal Roofing

Provide the following roofing contractor's guarantee on the General Contractor Guarantee:

The roofing contractor shall guarantee materials and workmanship associated with the roofing, flashings, and sheet metal work incidental to the work required under the roofing subcontract, against defect due to faulty materials or workmanship for a period of two (2) years from the date of Final Completion of the entire Project. It is understood and agreed by all parties hereto that the responsibility of the roofing contractor under this guarantee form, or any contract document, shall be in accordance with the roofing contractor's limited guarantee.

G.20.3.2 Owner's Agreement, Metal Roofing

Provide the following Owners Agreement on the Contractor Guarantee:

The undersigned named Owner for the Commonwealth, agrees, from the date of Final Completion of the entire Project, to maintain the roof in accordance with the manufacturer's written requirements and agrees to avoid damage to the roof surface by any parties under his control working or walking on the roof. The Owner recognizes his responsibility to inspect the roof semi-annually.

G.20.3.3 Contractor's & Manufacturer's Guarantee for New Construction and Re-roofing, Metal Roofing

The (General) Contractor shall furnish as a minimum, for all pre-engineered buildings and other standing seam roofing systems on buildings for uses other than utility or storage, a manufacturer's twenty (20) year non-prorated watertightness warranty / guarantee from the date of Final Completion of the entire Project. A manufacturer's twenty (20) year finish warranty against fading, chalking and film integrity is recommended when an applied finish is specified. The contractor shall provide a workmanship warranty agreeing to maintain the entire roof system(s) in a completely watertight condition at no cost to the Owner for two (2) years from date of *Final Completion of the entire Project*.

G.20.3.4 Wind Uplift, Metal Roofing

A wind uplift performance rating equivalent to UL Class 90 (U.L. Test 580) is recommended on all buildings for uses other than utility or storage. The roofing system shall meet the wind loads required by the VUSBC Chapter 16.

G.20.4 NRCA Roofing and Waterproofing Manual, Metal Roofing

Comply with additional recommendations of manufacturer and NRCA Handbook.

G.20.5 Approved Applicator, Metal Roofing

Specify that the roofing applicator shall be approved by the materials manufacturer.

G.20.6 Roof Protection, Metal Roofing

All specifications must state that before moving equipment or materials over a roof, the Owner, General Contractor, Roofing Contractor, and any of their agents must protect the roof from damage during and following roofing work. Movement of equipment and materials without roof protection shall be cause for the Owner, General Contractor, Roofing Contractor or A/E to stop work until protection is provided and any damage is corrected.

G.20.7 Final Inspection, Metal Roofing

The following items must be given to the Owner's representative at the Final Inspection:

1. A copy of the (general) contractor's and roofing contractor's two-year guarantee.
2. A copy of the roofing manufacturer's warranty/guarantee.
3. Copies of the History of Roofing Installation, Sample Form A; and Roof Information Worksheet – Sheet Metal Roofing, Sample Form C. The A/E shall obtain forms from the Owner and complete all applicable items.

G.20.8 Warranty Inspections, Metal Roofing

1. Representatives of the Owner (and the A/E), the Contractor, the Roofing Subcontractor, and the Roofing Manufacturer shall inspect the roof(s) between nine months and one year before the closing of the General Contractors one year guarantee.

2 The Owner shall also have the roof inspected at least three months before the two year guarantee expires and notify the Contractor in writing of any defects noted. The Owner shall require that any defects be corrected at least 30 days prior to expiration of the guarantee.

G.21 THE ROOF INSPECTOR

The minimum qualifications below serve as criteria for Owners who must select an outside, full-time roofing inspector

1. The Inspector should have a thorough knowledge of roofing details, flashing, and systems employing single-ply, built-up, metal, shingle, slate, or other membranes as the main weatherproof barrier.
2. The Inspector shall have attended roofing related education in formal schools or seminars sponsored by agencies such as AIA; BURSI; RCI, Inc.; CSI; NRCA; or roofing manufactures' training courses and shall obtain a minimum of twelve continuing education units annually in such courses, or shall have a current Registered Roof Observer Registration from RCI, Inc. Inspectors with other training must submit qualifications and be approved by BCOM in advance.
3. The Inspector shall be thoroughly familiar with the latest edition of the NRCA Roofing and Waterproofing Manual and specialized manuals prepared by NRCA.
4. The Inspector shall have a minimum of five years of full-time, practical roofing experience or approved equivalent experience.
5. The Inspector shall identify, in writing, at least three projects where he has been the full-time roofing inspector. He should provide names, addresses, and telephone numbers of roof owners and Architects/ Engineers for the roof projects.
6. The Inspector shall be trained and competent in the services he is providing
7. Roof Inspector's Scope of Work:
    a. The Inspector shall monitor the work for compliance with the contract documents
    b. The Inspector shall continuously monitor and observe the work at the point of application during installation of the roof.
    c. The Inspector shall immediately report any deficiencies or deviations to the Architect and Owner. A written report shall follow an oral report within two business days.
    d. The Inspector may recommend suspension of work or rejection of non-complying work to the A/E and Owner.
    e. The Inspector shall not:
        i. Authorize deviations form the contract documents.
        ii. Enter the area of responsibility of the Contractor's superintendent.
        iii. Issue orders on any aspect of construction means, methods, techniques, sequences, procedures, or safety in connection with the work.
    f. The Inspector shall keep a daily log (refer to the form at the end of this appendix.) for each project and shall give a copy of the log to the roofing contractor, the A/E, and the owner. The Inspector shall record all pertinent information such as weather, daily progress, workmen on the job, material storage, deck condition, bitumen temperature, installation procedures, quality of workmanship, job-related visitors, and so forth. See Section G.24 Roofing Forms

G.22 THE ROOF CONSULTANT/INSPECTION SERVICES PROVIDER

The Consultant should have the following qualifications:

1. Roof consulting and testing services should be the Consultant's full-time occupation.
2. The Consultant shall have a minimum of five years of field experience in providing the service
3. The Consultant shall have completed at least three service contracts in the recent past. Work for each of the completed contracts should be roughly equivalent in size and complexity to the proposed work.
4. The Consultant shall be required to submit three complete surveys of roofs that were repaired,

recovered or replaced. The survey shall include names, addresses and telephone numbers of roof owners and Architects or Engineers responsible for preparing the drawings and specifications.

5. The Consultant shall have attended roofing related education in formal schools or seminars sponsored by agencies such as AIA; BURSI; RCI, Inc.; CSI; NRCA; or roofing manufactures' training courses and shall obtain a minimum of twelve continuing education units annually, or shall have a current Registered Roof Consultant Registration from RCI, Inc. Consultants with other training must submit qualifications and be approved by BCOM in advance.
6. The Consultant should be trained, experienced, and competent in performing required services.
7. If testing is required, The Consultant shall be appropriately trained, certified, and licensed in the testing procedures (infrared, nuclear, electronic leak detection, core sampling, ASTM procedures, gravimetric analysis; and so forth) required for the service.
8. The Consultant should submit documented experience of the firm and resumes of all participating employees.
9. The Consultant's resume should describe other related services and contributions, such as writing, lecturing, and serving as an expert witness. The Consultant should list a professional qualifications or licenses.
10. The completed resume form must be submitted with the roof Consultant's response to the Owner's request for proposal. It will be used with other required items to evaluate the applicant.

G.23 NON-DESTRUCTIVE (NDE) ROOFING SURVEYS

A non-destructive (NDE) Survey uses infrared, nuclear, electronic field vector mapping or electronic leak detection to locate unacceptable moisture within a roofing system.

An NDE survey is mandatory before a newly constructed roof may be accepted. Depending on the size and condition of an existing roof, a survey may or may not be required before an Agency may repair or replace the roof. The following outlines requirements for NDE surveys:

1. Equipment, subject to the Owner's approval, shall be equal to the following:

    a. Infrared: A camera designed for the intended application and capable of taking thermograms
    b. Nuclear: A nuclear hydrogen detection (NHD) meter used for the measurements of reflected neutrons that can be linked to the presence of water in the roofing system
    c. Electronic Field Vector Mapping (EFVM) or Electronic Leak Detection: Generator and receiver designed for the intended membrane leak detection used for roofing and waterproofing.

2. Surveys

    a. Infrared: Provide a complete survey of the roof or roofs. Outline all anomalies with spray paint. Provide a thermogram showing the outlines and daylight photographs of all anomalies. If video thermogram imaging is used, provide the Owner with the video tape of the survey. Roof markings, thermogram, and photographs shall be numbered so that features can be readily identified and coordinated.

        Walkover surveys shall be performed in a pattern of 20'-0" maximum (20 foot maximum distance between walk paths); however; the distance between walk paths shall not exceed the sensitivity of the instrument being used. Instrument sensitivity shall permit recognition of areas of wet insulation as small as 6 inches on a side. Survey inspection procedures, reports, etc. shall be conducted in accordance with the requirements and procedures in ASTM C1153, "Standard Practice for Location of Wet Insulation in Roofing Systems Using

Infrared Imaging," except as otherwise noted in this Appendix.

b. Nuclear: Provide a grid, comprising 5' x 5' grid unit, to completely cover the roof or roofs. Mark each grid intersection with spray paint. Take readings at the inter-sections and record them on a roof plan. Provide daylight photographs of area of anomalies.
c. Electronic Leak Detection: Provide a complete survey of all roof or waterproofing areas. Mark, number, and photograph all anomalies on the membrane surface. After field testing is complete submit a report with all anomalies located on a roof plan. Photographs of each anomaly shall be included in the report. Test the entire roof area on an area by area basis not to exceed 5,000 SF. Readings taken with the receiver shall be done on a 24" x 24" grid pattern.
d. Electronic Field Vector Mapping (EFVM): Provide a complete survey of all roof or waterproofing areas. Mark, number, and photograph all anomalies on the membrane surface. After field testing is complete submit a report with all anomalies located on a roof plan. Photographs of each anomaly shall be included in the report. Mapping shall be done in accordance with standard practices over the entire roof surface.

3. Core Samples

Since NDE surveys are not able to measure moisture in roofs directly - nuclear equipment responds to hydrogen emissions, infrared to heat changes - core samples to measure actual moisture content must be taken from surveyed roofs and correlated with NDE readings (See Exception below for roofs with no anomalies). The samples shall be taken as follows:

a. One is required on roofs showing no anomalies. Additional cores are not required if the Consultant can show that moisture is not causing detected anomalies. The Consultant shall identify such anomalies and explain their cause in a written report to the Owner.
b. On all other roofs a minimum of one dry and one wet core shall be taken from each roof surveyed.
c. As many cores as needed should be taken to establish moisture counts and changes, but no more than five cores shall be taken from any roof.

Exception: If no anomalies are shown by the survey equipment and the owner's full time roof inspector was present on the site during all roofing applications and had not noted any roofing applications where moisture was present in the form of rain, dew, mist or entrapped moisture the requirement for a minimum of one roof core into a newly installed assembly may be waived by the owner.

4. Gravimetric Analysis

As soon as possible after samples are taken, core should be sealed in air tight containers and taken to a laboratory for analysis.

a. Analyze samples gravimetrically to determine percent of moisture in any required core sample taken from new roofs and, unless waived for justifiable reasons, from existing roofs.
b. Identify all materials - surfacing, membrane (and number of plies), insulation, vapor barriers, adhesives, etc. - in the cores.

5. Moisture Conditions

The Surveyor shall correlate survey reading results with actual moisture conditions determined by core samples gravimetrically analyzed. The correlation shall be shown or tabulated on the drawings.

6. Report

The Consultant shall submit a written report explaining the problems.

a. Reports for existing roofs shall
   (1) Identify and describe all anomalies.
   (2) Identify and describe any visual survey defects that may be harmful to the roof.
   (3) Give the causes for each anomaly and defect.
   (4) Recommend alternate courses of corrective action for defects and anomalies harmful to the roof.
   (5) Provide the cost estimate for correcting the defects and anomalies.

. b. Reports for new roofs where a design professional is providing construction administration services shall
   (1) Identify and describe all anomalies.
   (2) Identify and describe any visual survey defects that may be harmful to the roof.
   (3) Give the causes for each anomaly and defect.

C.23.1 Drawings
The consultant hired to survey roofs shall provide plans complying with the following:

1. General Requirements are
   a. Print size, preferred is, 24" x 36"; but in no case larger than 36"x46"
   b. Minimum drawing scale is 1/8" = 1'-0" for roofs or portions of roofs surveyed
   c. Provision of one reproducible print (Mylar, etc.) and two non-reproducible prints, as a minimum, for each sheet of drawings

The Owner may make changes to these minimum requirements to suit his archiving needs.

2. Drawings shall include the following as a minimum:
   a. Show all roofs surveyed
   b. State identification, title, and date
   c. Provide an orientation north arrow and drawing scale
   d. Indicate the area of each roof and approximate overall dimensions
   e. Indicate all existing features, equipment, and roof penetrations of whatever nature (such as vents, stacks, drains, hatches, skylights, screens, railings, mechanical equipment, etc.) shall be accurately indicated, identified, and drawn to scale.
   f. Note all roof slopes and valleys with drainage arrows. If there is no slope, state that the roof is dead level.
   g. Identify the height of roof flashings.
   h. Show and explain all roofing defects and anomalies.
   i. Delineate, for an infrared survey, moisture anomalies with contour lines; for a nuclear survey, show all grid point readings and define areas having unacceptable moisture by contour lines. Show where core samples were taken. Correlate nuclear grid point readings and infrared contour changes to percent of moisture. Dimension areas recommended for removal and locate them with respect to fixed identify-able features (such as parapets).
   j. Provide at least one detail section (3/4" = 1'-0" minimum) showing roof construction where core samples were taken; more if there are differences in construction from core to core. Identify surfacing material, membrane product, insulation type and thickness, vapor barrier if used, and deck construction.

G.24 ROOFING FORMS

Standard DGS forms and formats are available for download from the DGS Forms Center.

For a listing of current DGS forms applicable to the design and construction process, download Form DGS-30-000 (Capital Management Forms Available for Download from the DGS Forms Center).

The following roofing forms are available for download from the Forms Center:

Form Number	Description	File Type
DGS-30-328	Roofing - Installation History	Word
DGS-30-332	Roofing - Built-up Roofing Data	Word
DGS-30-336	Roofing - Metal Roofing Data	Word
DGS-30-340	Roofing - Shingle Roofing Data	Word
DGS-30-344	Roofing - Single Ply Roofing Data	Word
DGS-30-348	Roofing - Inspection Checklist	Word
DGS-30-352	Roofing - Daily Inspection Log	Word
DGS-30-356	Roofing - Consultant / Inspector Resume	Word

To view/download the latest version of a form, visit the website listed above and enter the Form Number (e.g., “DGS-30-328“) in the search box on the Forms Center.

Additional instructions for viewing and downloading forms are available in the Help Guide on the DGS Forms Center.