

DIVISION 50 – MINIMUM DESIGN REQUIREMENTS

SECTION 50 50 00 – 19th CES CIVIL/STRUCTURAL DESIGN CRITERIA AND EXPECTATIONS

PART 1 - GENERAL

1.01 GENERAL

- A. It is not the intent of these standards to inhibit design creativity. The intent is to introduce the designer to LRAFB standard design practices.
- B. Sustainability
 - 1. MILCON projects are expected to meet minimum LEED criteria for sustainable design. Each such project will define a rating expectation (silver, platinum, gold, etc.), and decisions will be required on which ones are attainable for the project.
 - 2. A life-cycle cost analysis is expected for selection of any roofing system other than SSMR for new construction. Results of that analysis, and resulting recommendations, are expected at the 35% design submittal.
 - 3. All designs shall consider recycled material products. Products that utilize recycled materials shall be highlighted in the design analysis.
- C. Codes and Requirements:
 - 1. Designers shall conduct a thorough code review, and include all applicable requirements into the design. Listed below are some design requirements and resources:
 - a. Whole Building Design Guide: <http://www.wbdg.org/>
 - b. Unified Facility Criteria (UFC) http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4
 - c. UFC 1-200-01 General Building Requirements - Review this document as it is applicable to all new and renovated Government-owned facilities for the Department of Defense. Review this document for current International Building Code (IBC) adoption, and other design criteria requirements.
 - d. Unified Facility Guide Specifications (UFGS) : http://www.wbdg.org/ccb/browse_cat.php?c=3
 - e. Air Force Criteria: http://www.wbdg.org/ccb/browse_org.php?o=33
 - f. Air Force Civil Engineering Support Agency (AFCESA) Engineering Technical Letters (ETLs) : http://www.wbdg.org/ccb/browse_cat.php?c=125
 - g. SDDCTEA Design Manuals: http://www.tea.army.mil/pubs/nr/DynaListDOD.asp?Cat_id=4&Sub_id=14&Topic_id=0&Cat_Name=DOD%20Programs%20for%20National%20Defense&Topic_Name=Pamphlets%2C%20Manuals%2C%20and%20Directories
 - h. Tri-Service Transportation Design Criteria: <https://transportation.wes.army.mil/triservice/criteria.aspx>
 - i. Architectural Barriers Act (ABA): <http://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/aba-standards>
 - j. Federal Highway Administration (FHWA):

- i. Manual on Uniform Traffic Control Devices (MUTCD):
http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm
- ii. Standard Highway Signs and Markings (SHSM):
http://mutcd.fhwa.dot.gov/ser-shs_millennium.htm For new or replacement signage follow the minimum retroreflectivity levels in SDDCTEA Pamphlet 55-14 Traffic Engineering for Better Signs and Marking, section 2.1.8 Minimum Retroreflectivity Levels.
- k. Pavement-Transportation Computer Assisted Structural Engineering (PCASE): <https://transportation.wes.army.mil/pcase/Default.aspx>
- l. Hydrologic Engineering Centers River Analysis System (HEC-RAS):
<http://www.hec.usace.army.mil/software/hecras/>
- m. Hydrologic Engineering Centers Hydrologic Modeling System (HEC-HMS):
<http://www.hec.usace.army.mil/software/hechms/>
- n. Federal Highway Administration: <http://www.fhwa.dot.gov/>
 - i. FHWA Publications: <http://www.fhwa.dot.gov/resources/pubstats/>
 - ii. Alkali-Silica Reactivity Field Identification Handbook:
<http://www.fhwa.dot.gov/pavement/concrete/asr/pubs/hif12022.pdf>
- o. Arkansas State Highway and Transportation Department (AHTD):
<http://www.arkansashighways.com/>
 - i. Roadway Design Division, Roadway Design Guidelines, Drainage Manual, and Manuals & Standard Roadway Drawings:
http://www.arkansashighways.com/roadway_design_division/roadway_design.aspx
 - ii. AHTD Specifications:
http://www.arkansashighways.com/standard_spec_2003.aspx
 - iii. AHTD Qualified Products List (QPL):
http://www.arkansashighways.com/materials_division/materials.aspx#
- p. Arkansas Department of Environmental Quality (ADEQ):
<http://www.adeg.state.ar.us/>
 - i. ADEQ Construction Stormwater Program:
http://www.adeg.state.ar.us/water/branch_permits/general_permits/stormwater/construction/construction.htm
 - ii. USGS National Field Manual for the Collection of Water Quality Data:
<http://water.usgs.gov/owq/FieldManual/>
- q. Arkansas Department of Health:
 - i. Arkansas Department of Health, Engineering Home:
<http://www.healthy.arkansas.gov/programsServices/environmentalHealth/Engineering/Pages/default.aspx>
 - ii. Arkansas Department of Health, Rules and Regulations:
<http://www.healthy.arkansas.gov/programsServices/environmentalHealth/Engineering/Pages/RulesRegulations.aspx>

- iii. Arkansas Department of Health, Plan Review Program:
<http://www.healthy.arkansas.gov/programsServices/environmentalHealth/Engineering/planReview/Pages/default.aspx>
- iv. Arkansas Department of Health, Engineering Reports and Forms
<http://www.healthy.arkansas.gov/programsServices/environmentalHealth/Engineering/Pages/ReportsandForms.aspx>
- r. Ten State Standards for Water and Wastewater:
<http://10statesstandards.com/index.html>
- s. American Water Works Association Bookstore:
<http://www.awwa.org/Resources/Standards.cfm?ItemNumber=33777&navItemNumber=33778&showLogin=N>
- t. US Army Corp of Engineers (USACE) Regulatory:
<http://www.swl.usace.army.mil/regulatory/>
- u. United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)
 - i. Web Soil Survey: <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>
 - ii. Technical Resources:
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/>
- v. National Roofing Contractor's Association (NRCA): <http://www.nrca.net/>
- w. Metal Building Manufacturer's Association (MBMA): <http://www.mbma.com/>
- x. Registered Roof Consultants (RRC) and Registered Roof Observer (RRO) Directory: http://members.rci-online.org/wcm/RCIWeb/Directories/RCIWeb/Member_Listing.aspx?
- y. Computer Aided Design (CAD) Standards: <https://cadbim.usace.army.mil/cad>
- z. GIS
 - i. Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) Standards: <http://www.sdsfie.org/>
 - ii. U.S. Air Force GeoBase: Installation Geospatial Information & Services (this site may require CAC)
<https://cs.eis.af.mil/a7cportal/ProgramGroups/Resources/Pages/GeoBase.aspx>
- aa. Defense Installation Spatial Data Infrastructure (DISDI):
<http://www.acq.osd.mil/ie/bei/disdi.shtml>
- bb. International Building Code (IBC):
<http://publicecodes.cyberregs.com/icod/ibc/index.htm>
- cc. United States Army Corps of Engineers (USACE) Protective Design Center:
<https://pdc.usace.army.mil/>
- dd. Federal Aviation Administration: <http://www.faa.gov/>
- ee. Pulaski County Government (Arkansas) Planning and Development:
<http://co.pulaski.ar.us/planning6.shtml>

2. All designs shall comply with the UFC 4-010-01 Department of Defense Minimum Antiterrorism Standards for Buildings.
3. All designs shall comply with the seismic requirements of UFC 3-310-04 Seismic Design for Buildings.
4. All designs shall comply with the seismic requirements of UFC 1-200-01 Design: General Building Requirements.
5. Structural codes and references: Comply with current editions of ACI 318 Building Code Requirements for Structural Concrete, ACI Committee 302 Report, Guide to Concrete Floor and Slab Construction, ACI 360R Design of Slabs on Ground, ACI Manual of Concrete Practice, ASCE 7 Minimum Design Loads for Buildings and Other Structures, International Building Code, TM 5-809-6/AFM 88-3, Chapter 6 Structural Design Criteria for Structures Other Than Buildings, TM 5-809-12 / AFM 88-3, Chapter 15 Concrete Floor Slabs on Grade Subjected to Heavy Loads, TI 809-02 Structural Design Criteria for Buildings (including applicable references in Tables 1-1, 1-2, 1-3 Design Document Summaries), UFC 3-301-01 Structural Engineering, UFC 3-310-01 Structural Load Data, as is applicable.
6. All designs shall comply with the reliability and maintainability design checklist (ETL 01-01) and the Little Rock AFB constructability checklist. For example for concrete design, provide a complete concrete design analysis of all major structural features, e.g. grade beams, foundation, floor slabs, columns, retaining walls. Show the work of how or why design decisions are made in sizing members, reinforcement chosen, and based on specific applicable references, e.g. American Concrete Institute, Concrete Reinforcing Steel Institute, Portland Cement Association, Precast/ Prestressed Concrete Institute, ASTM, International Building Code, TM/AFM, UFC. This includes design-build and design-bid-build project contracts.

7. STORM WATER:

EISA Section 438 (Title 42, US Code, Section 17094) established into law storm water design requirements for Federal development and redevelopment. Under these requirements, Federal facility projects over 5,000 square feet must “maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. Reference DUSD (IE) Policy Memo dated 19 Jan 2010, “DoD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Acts (EISA)”. A copy of this memo is in the LRAFB Standard Specifications Division 50 “Minimum Design Criteria, Folder 7 Civil & Structural Requirements. Under EISA Section 438 requirements, Federal projects with a footprint over 5,000 square feet shall comply with UFC 3-210-10, Low Impact Development.

8. DIG PERMITS

Any design or construction work that penetrates the ground surface requires a LRAFB Approved Dig Permit prior to conducting work. Coordinate with the 19th CES Project Manager or Construction Manager to start the dig permit process. Dig permit approval can take 2-3 weeks, so plan accordingly.

9. GROUND PENETRATING RADAR

On all projects where excavation and/or below grade utility locating is required, Ground Penetrating Radar (GPR) shall be accomplished by the Contractor to locate all subsurface structures, utilities, etc. The GPR equipment shall identify all underground structures to a depth of 8 feet. Coordinates provided shall be within an accuracy of 4 inches. GPR equipment shall include GPR antenna, electromagnet pipe locator, Traceable Rodder and

GPS as required to meet depth and accuracy described above. Deliverables shall include the following:

- a. AutoCAD showing all utilities found using GPR.
- b. All information in GIS.
- c. See section 01 33 00 1.03 Geographic Information System (GIS) Service for detailed information regarding requirements for GPR deliverables.

Excavation as related to GPR is defined as digging earth materials or penetrating earth materials to a depth greater than that of the top soil in vegetative areas, below the top of subgrade surfaces in paved areas or areas under existing or proposed structures, or deeper than 4 inches in other areas. Inserting soil anchors, driving ground rods, and similar activities are considered excavation and require GPR in advance of these activities.

10. CONCRETE JOINT LAYOUT

Designers shall provide a joint layout for all concrete work including structural and non-structural concrete. Provide details for each joint type to include expansion joints, contraction joints, and construction joints. This is applicable to all horizontal areas of concrete to include mezzanines (even if it is planned to receive a surfacing), drives, sidewalks, roads, airfields, parking areas, dumpster pads, facility entrances. Provide fillets. Where possible, joints shall not end in angles less than 90 degrees. Joint shall have a clean vertical face. Length to width ratio shall be .75 to 1.25. Joint spacing will be based upon thicknesses found in standard concrete practices or applicable Unified Facility Criteria. Bottom line, the construction drawings will have a joint layout plan.

11. CONCRETE MIX DESIGNS

All concrete mix designs shall include a minimum of 25% Class F Fly Ash to aid in mitigating Alkali Silica Reaction (ASR). The only exception shall be for interior structural concrete members not exposed to moisture. The requirement for 25% Class F Fly ash includes, but is not limited to airfield concrete, slabs on grade, curb and gutter, sidewalks, concrete bridges, and concrete foundations.

1.02 SURVEYING

A. First Floor Elevations must be certified by a Licensed Surveyor.

B. HORIZONTAL DATUM:

The Arkansas State Plane Coordinate System (ASPCS) South based on the North American Datum of 1983 (NAD83) shall be used as the coordinate system and horizontal datum for projects.

C. VERTICAL DATUM:

The vertical datum shall be the National Geodetic Vertical Datum of 1988 (NGVD88). If the vertical datum for the prior surveys are determined not to be based on NGVD88, the surveyor shall provide the conversion formula relating to other known datum's of record.

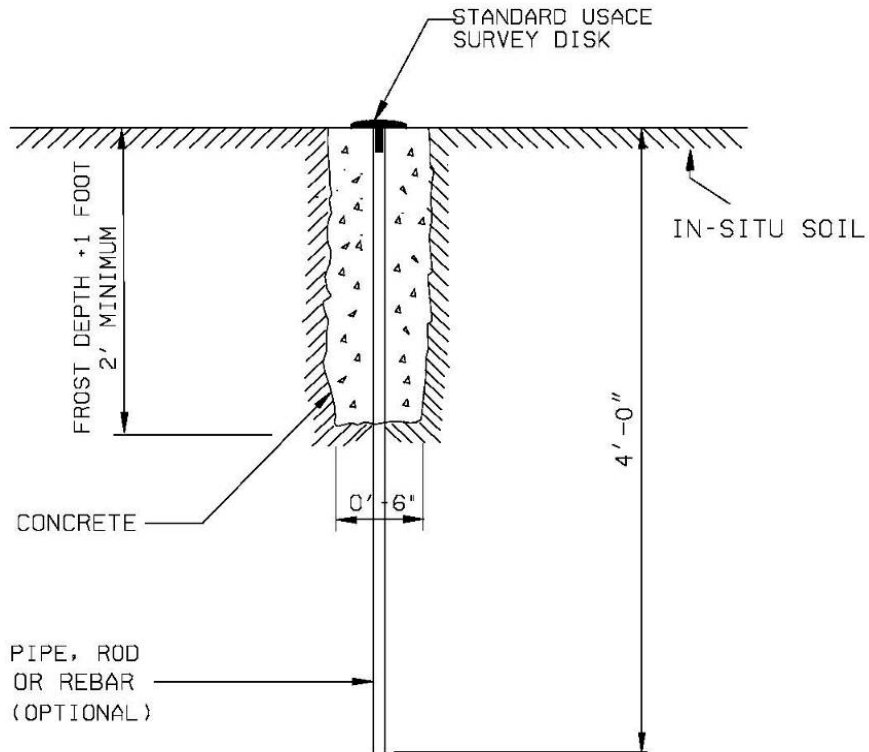
D. TERPS

Follow datum requirements of AFI 11-230. AFI 11-230, dated 30 Mar 2010, paragraph 1.5.12.3 states: All coordinates must be expressed as World Geodetic System-84 (WGS-84) coordinates to at least two places past the decimal, with the map being associated to this

coordinate system. The State Plane Coordinate System is not an acceptable aeronautical survey format.

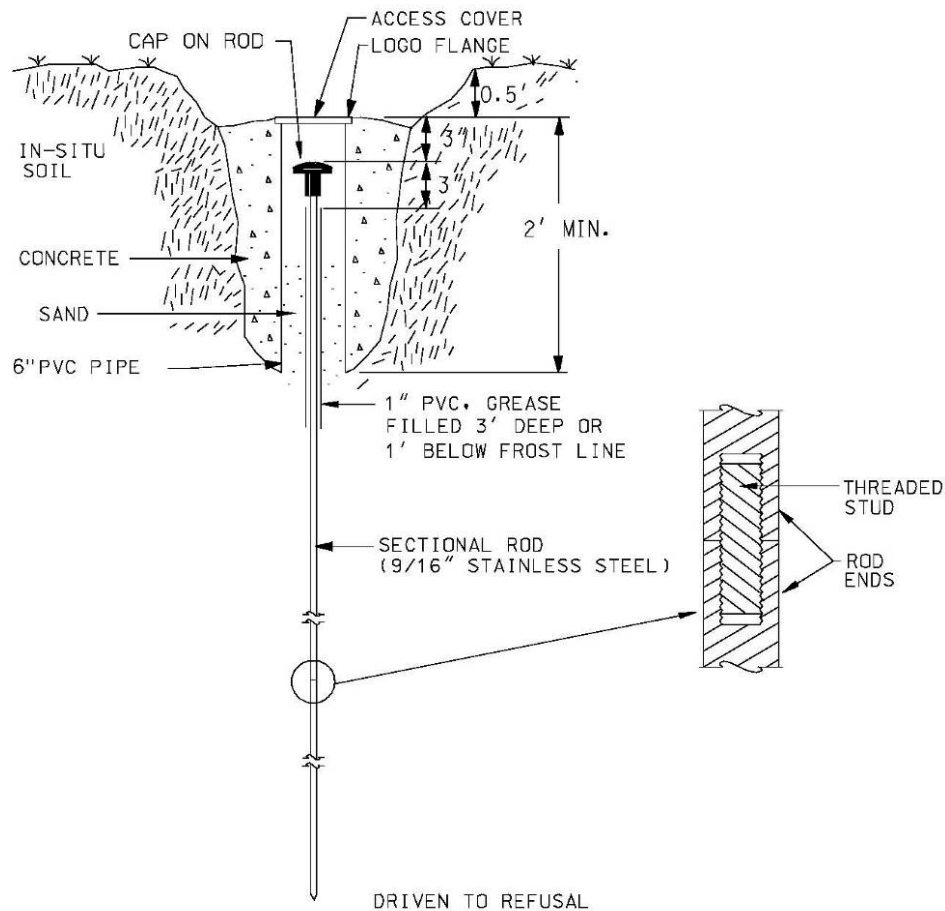
E. MONUMENTS AND BENCHMARKS:

1. Follow standards of US Army Corp of Engineers, Engineering and Design, Survey Markers and Monumentation, EM 1110-1-1002. This can be downloaded at <http://publications.usace.army.mil/publications/eng-manuals/> .
2. Records and maps of known on base monuments and benchmarks can be obtained from 19CES Engineering Flight, Technical Support Section
3. New Monuments and Benchmarks shall be set by a Licensed Surveyor.
4. Submit documentation of new monuments and benchmarks to 19 CES Engineering Flight, Technical Support Section. See Chapter 6 of EM 1110-1-1002 for documentation requirements. Coordinate with 19 CES Engineering Flight, Technical Support Section before setting new monuments or benchmarks. The brass caps will be stamped with a benchmark ID number and date. Coordinate with the 19CES Programs Flight, Technical Support Section for Monument Layout, ID number and date format. For all newly placed benchmarks submit to the 19 CES Program Flights, Technical Support Section, to be included in the Base's Benchmark Records and Maps, the following information: ID Number, Date Installed, Arkansas State Plane Coordinate System South Northing and Easting, NGVD88 Elevation, NAD83 Latitude and Longitude, Licensed Surveyor's Name and Contact Information who installed the benchmark, and any useful notes to aid in locating the benchmark.
5. Typical Monument Caps can be viewed in Appendix B of EM 1110-1-1002. Utilize the typical monument cap layout and size in a type compatible with the type of monument being set. In lieu of "CORP OF ENGINEERS – US ARMY" monuments shall bear the heading "LITTLE ROCK AFB – USAF"
6. Monument and Benchmark Type and Construction Details: Follow EM 1110-1-1002 Chapter 3.
7. Typical monuments on LRAFB would be a Type G monument as defined in EM 1110-1-1002. The construction details are illustrated in Figure 3-12. The Type G mark is constructed by excavating a 15-centimeter (6-inch)-diameter by 60-centimeter (2-foot)-deep hole. In areas where the maximum frost depth is greater than 2 feet, the excavated depth should be 1 foot below the maximum frost depth. The USACE disk may be driven into a 4-foot by 3/4-inch diameter pipe or on a 4-foot by No. 5 reinforcement steel bar (rebar). The pipe or bar assembly is then driven into the center of the hole until the disk is slightly above the surface. The hole is then filled with concrete to the disk. The use of a pipe or rebar is optional. The disk may be pushed directly into the fresh concrete; however, a magnet shall be placed in the concrete if pipe or rebar is omitted. The reactive nature of non-common materials may cause problems when placing aluminum caps on rebar. The use of a plastic insert serves as a barrier for the reaction and may prolong the life of the monument. The plastic insert is not necessary when using a standard brass disk. Below is a figure of a Type G monument.



8. At a minimum new benchmarks shall be set as follows: 8" Diameter concrete collar, 24" deep, with a 5/8" rebar approximately 4' long, and a brass cap set on the rebar.

9. In sensitive clay areas install a Type B monument as defined in EM 1110-1-1002. When the site geology is known to consist of sensitive clays, the Type B rod mark should be used. The PVC sleeve should extend through the sensitive clay layer. The anchored section should be driven to refusal. When the site geology is known to consist of lacustrine clays, the Type B rod mark should be used. The PVC sleeve should extend through the highly desiccated soil. Reference Chapter 3 EM 1110-1-1002 for construction details of a type B monument. Below is a figure of a type B monument.



USE FOR VERTICAL AND HORIZONTAL CONTROL

F. AERIAL IMAGERY

Prior to flying missions for aerial imagery coordinate with 19th AW Airspace Manager and 19th AW/XP.

1.03 UTILITY SYSTEMS

A. GENERAL:

1. All utilities shall be marked with tracing wire and warning tape on all new underground utilities.
2. All utility crossings of primary and secondary roadways shall be accomplished by trenchless technology. If a waiver for open cut is approved, then a 8" 3,000 psi concrete bridge cap shall be provided that is supported by a minimum of 9" on the unexcavated sides of the trench and is capped with 2" HMA surface course. Sawcuts shall be neat and vertical. Install 4x4 No 10 gauge wire mesh at mid depth of concrete bridge over entire area.

B. Fire Protection Engineering

Reference UFC 3-600-01 Fire Protection Engineering for Fire Lane Access, Water Supply for Fire Protection, Fire Hydrants, Fire Department Connections. Fire Lane Access must take into account AT requirements. See Pavement Thickness Design below for Fire Lane Access Design.

C. WATER SERVICE/DISTRIBUTION.

The water distribution lines are owned and maintained by the City of Jacksonville, Arkansas. All connections and water distribution lines shall be coordinated with the City of Jacksonville. All design and construction shall be in accordance with the City of Jacksonville's details and specifications. Please see attached specifications and details. Prior to start of design or construction contact the City of Jacksonville water department.

~~Any new line or replacement that exceeds 800 feet in length or has the potential to change the flow characteristics of the existing distribution system must be reviewed and approved by the Arkansas Department of Health and Human Services (ADHHS).~~

- ~~1. Design of potable water systems shall meet ADHHS and Ten States Standards for Water Works.~~
- ~~2. All exterior water lines shall be AWWA C900 PVC, DR 18 with ductile iron fittings.~~
- ~~3. Replacement of water mains and fire hydrant lines with C900 PVC pipes, tape and tracer wire. Locator wire shall be 10 gauge AWG solid, single conductor, insulated copper wire.~~
- ~~4. All valves shall be ductile iron or bronze gate valves. At TEES a gate valve should be installed on each branch; 3 gate valves per tee. Maximum distance between in-line gate valves is 500 feet.~~
- ~~5. Connections from new water mains to existing water mains shall be accomplished using a tapping valve tapping saddle connection. Provide a typical detail.~~
- ~~6. Ebba Megalugs are required at all MJ-MJ connections.~~
- ~~7. All valve, service and meter boxes shall be cast iron and rated for traffic loads.~~
- ~~8. All fire hydrants shall be 5 1/4 inch dry barrel type conforming to AWWA C502 and shall be a Mueller. Maximum distance between fire hydrants is 300 feet.~~
- ~~9. All PIV's shall conform to NFPA 24 and be provided with tamper switch connected to the buildings fire alarm system.~~
- ~~10. Connection to existing water lines shall be by "hot tap" with tapping valve and sleeve.~~
- ~~11. New lines shall be disinfected and hydrostatic pressure tested to meet ADHHS, Ten States Standards for Water Works, and industry standards.~~
- ~~12. Water meters and backflow preventers shall be installed in accordance with requirements specified in the LRAFB Mechanical Design Guide.~~
- ~~13. All above ground appurtenances shall be painted Sherwin-Williams Bronzetone unless otherwise specified. Fire hydrants shall have the top color coded to indicate flow/pressure.~~

D. SANITARY SEWER.

Any new line or replacement that exceeds 800 feet in length or has the potential to affect the capacity of the existing system must be reviewed and approved by the Arkansas Department of Health and Human Services (ADHHS).

1. Design of sanitary sewer systems shall meet ADHHS and Ten States Standards for Wastewater Facilities.
2. All sanitary sewer lines should be SDR 26 PVC.
3. All manholes shall be cast in place or pre-cast concrete with water seals at all joints to preclude infiltration of groundwater.

E. STORM SEWER.

1. All storm sewers shall be reinforced concrete pipe.
2. Flared end sections are required – headwalls are not acceptable.

F. NATURAL GAS: Refer to the LRAFB Mechanical Design Guide for these requirements.

1.04 SITE WORK AND PAVEMENTS

- A. Erosion control devices appropriate for each site shall be designed and provided to ensure compliance with ADEQ and LRAFB requirements.
- B. Design shall comply with UFC 3-210-02, Low Impact Development.
- C. Site drainage shall be designed to provide for positive drainage away from all structures on the site. Reference UFC 3-201-01.
- D. Roof drains: See sub paragraphs of paragraph GUTTER, DOWNSPOUTS, SCUPPERS, AND DRAIN SYSTEMS for design guidance.
- E. All disturbed areas shall be provided with 4" topsoil (fertile material free of trash, debris, and objects larger than ¾" diameter) and groundcover as follows:
 1. All areas shall receive Bermuda sod, unless otherwise stated. The sod shall be rolled to present an even surface. It shall also be appropriately staked or pinned on slopes and in waterways to prevent washout. Sod shall not be reinforced with plastic mesh fabric due to mowing considerations.
 2. In cases where seeding is allowed, the species is to be Bermuda and shall be applied by hydroseeding with a tackified mulch. Loose mulch such as straw and hay is not acceptable.
 3. Sod and seed types for the airfield must be approved by LRAFB to be compliant with the BASH program.
- F. Backfill & Structural Fill.
 1. "Donafil" (or other similar materials), organic materials, and expansive or highly plastic clays shall not be used on LRAFB as fill material.
 2. In general, clean sands, sandy-clays, and gravels are acceptable fill materials
- G. Concrete sidewalks shall be 4-1/2" thick by minimum 6'-0" wide unreinforced concrete (if reinforcement is required, fiber mesh shall be used). Provide a 4-inch thick base of crushed rock or washed gravel (not sand) for a capillary water barrier. Site conditions may dictate where a 6' wide minimum sidewalk may not be desirable, and proposed alternatives may be considered on a case by case basis for approval by the 19th CES Civil Engineer section.
- H. Curb and gutter shall be 6" upright barrier type with integral 18" gutter.
- I. Pavement Section Thickness Design

PCASE shall be used for pavement design. Pavement-Transportation Computer Assisted Structural Engineering (PCASE): <https://transportation.wes.army.mil/pcase/Default.aspx>

Submit PCASE files for review with design submittals. Use UFC 3-250-01fa Pavement Design for Roads, Streets, Walks, and Open Storage Areas. PCASE shall also be used to design Fire Lane Access drives.

1. Asphalt pavements shall be designed using PCASE in accordance with UFC 3-250-01FA, UFC 3-250-03, and UFC 3-250-18FA. Use the PCASE section except that the minimum flexible pavement section shall be 2" HMA surface course PG 64-22 per AHTD Specification Section 407 and placed per AHTD Spec Section 410, Tack Coat over full surface per AHTD Spec Section 401, 2" HMA binder course PG 64-22 per AHTD Specification Section 406 and placed per AHTD Spec Section 410, Prime Coat over full surface per AHTD Spec Section 401, over 9" Class 7 crushed aggregate base course per AHTD Specification Section 303 compacted to 98% modified proctor.

2. Road Shoulders: In road sections outside of curb and gutter, base course pavement section shall extend a minimum of 1 foot beyond pavement section to receive asphalt, on each side of the roadway, for a built up shoulder. After asphalt is paved shoulders shall be dressed flush with asphalt. Beyond the minimum 1' shoulders grade to drain away from road section.

J. Roadways and Parking Lots

1. Use UFC 3-250-18FA General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas

2. Where practical use Arkansas Highway Transportation Department Standard Roadway Drawings and Drainage Manual. Incorporate Drawings into LRAFB Standard Drawing Layout: http://www.arkansashighways.com/roadway_design_division/roadway_design.aspx

3. Where practical specify AHTD Specifications: Incorporate Specifications into LRAFB Standard format.

http://www.arkansashighways.com/Construc/2003REMANUAL/2003_RE_Manual.aspx

4. Parking Lot Design use:

- a. UFC 3-210-02 POV Site Circulation and Parking
- b. SDDCTEA Pamphlet 55-17, Chapter 17 Parking

K. Accessibility

Design shall meet the DoD Policy meeting Architectural Barriers Act (ABA) Guidelines for accessibility. These guidelines are published at www.access-board.gov.

1. For Handicap Parking Signs/Stalls, AMC Sign Standards require the following:

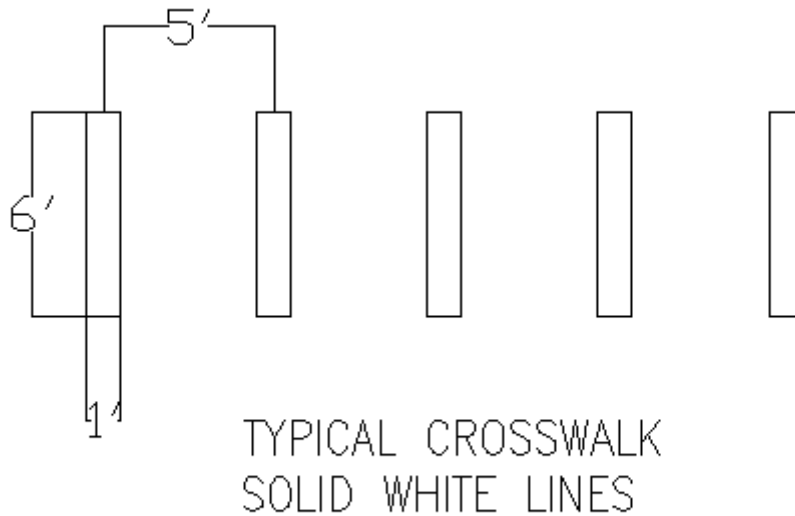
- a. ABA accessible parking spots will meet all ABA Accessible Design Standards including signage.
- b. Use the "Standard Brown" background color with "Standard White" letters and symbols for all handicapped parking signs. Use FHWA SHSM Book Regulatory R7-8 and R7-8a for Van Accessible parking stalls.
- c. Do not provide any handicapped symbols or wording to the parking surface of parking stalls. Handicapped parking access aisles will be striped in "standard white" by diagonal stripes, 4" wide, 2' on center. Blue color striping or sign panels are not acceptable. Do not display any "Fines" wordage or panel to handicapped signs.

- d. Handicap Signs shall be pole mounted. Use the clear height of 5'-00" to the bottom of the panel unless safety dictates use of the 7'-00" height.
2. Accessible routes shall not terminate into curbs; handicap ramps shall be installed. Projects including Design and Design-Build contracts which include installing sidewalks shall tie the sidewalks into the base sidewalk system. This means that if the project limits abut a roadway with a sidewalk crosswalk and the sidewalk across the street does not have a handicap ramp installed, the handicap ramp shall be installed as part of the project.
 3. Toe of handicap ramps shall be flush with pavement
 4. Reference SDDCTEA Pamphlet 55-17 Exhibit 11.3 for ADA Design Considerations.
- L. Traffic Engineering and Entry Control Facility Design shall follow applicable UFC and Military Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA) Design Pamphlets, Manuals , and Directories including those listed below. http://www.tea.army.mil/pubs/nr/DynaListDOD.asp?Cat_id=4&Sub_id=14&Topic_id=0&Cat_Name=DOD%20Programs%20for%20National%20Defense&Topic_Name=Pamphlets%2C%20Manuals%2C%20and%20Directories . SDDCTEA executes the Department of Defense's overall transportation engineering program on behalf of the military services.
1. SDDCTEA Pamphlet 55-14 Traffic Engineering for Better Signs and Markings
 2. SDDCTEA Pamphlet 55-10 Traffic Engineering for Better Roads
 3. SDDCTEA Pamphlet 55-15 Traffic and Safety Engineering for Better Entry Control Facilities
 4. SDDCTEA Pamphlet 55-8 Traffic Engineering Study References
 5. SDDCTEA Pamphlet 55-17 Better Military Traffic Engineering
- M. Signs and Markings
1. AMC Sign Standards shall be reviewed before specifying or detailing signage and pavement markings.
 2. Reference SDDCTEA Pamphlet 55-14, Traffic Engineering for Better Signs and Markings
 3. Follow MUTCD guidelines for sign and marking design.
 4. Use the Standard Highway Signs and Markings (SHSM) Book for signs.
 5. Except as noted by AMC Sign Standards, signs shape, colors, and general design shall conform to those in the MUTCD and the SHSM book.
 6. The backside of all signs shall have "standard brown" sheeting for full coverage. The backside of the sign that is "Standard Brown" is not required to meet the retroreflectivity standards.
 7. Standard Size Sign: If more than one size sign is included in the SHSM Book, the standard size would be the size indicated by a black box with a white "C" in it, which represents the standard size for conventional roadways; Reference SDDCTEA Pamphlet 55-14 Exhibit 2.3.
 8. Sign Supports (Reference SDDCTEA Pamphlet 55-14, Paragraph 2.1.13 and AMC Sign Standard)
 - a. Sign Supports shall be "standard brown" or dark bronze. Bolts and brackets will match the surface color where attached.

- b. For Signs with area less than 35 Square Feet steel Square Sign Posts shall be used. Submit from the steel square post supplier:
 - i. Certification Concerning FHWA's approval, including the maximum number of sign posts that are allowed within a 7-foot path
 - ii. Documentation showing the maximum sign area that the posts will support at various sign heights, based on the locale's design wind and soil conditions
 - iii. Proper installation instruction

9. Parking lot paint markings shall be white.

10. Crosswalk Markings: Reference SDDCTEA Pamphlet 55-17, Paragraph 11.4 CROSSWALKS for design considerations when considering crosswalks. Crosswalks shall be solid white line dimensioned as follows: 1' wide, 6' in the direction of vehicular travel, and spaced at 5' on center. See below figure for typical:



11. Marking Retroreflectivity: Reference SDDCTEA Pamphlet 55-14, paragraph 3.2.3. Supplement longitudinal lines with snowplowable raised retroreflective pavement markers (RRPMs). RRPMs shall be 3M Snowplowable Raised Pavement Marker RPM 190 (48mm width) or equal.

12. Sign Retroelectivity Standards Follow SDDCTEA design guidelines published at the following link:
http://www.tea.army.mil/pubs/nr/DynaListDOD.asp?Cat_id=4&Sub_id=14&Topic_id=0&Cat_Name=DOD%20Programs%20for%20National%20Defense&Topic_Name=Pamphlets%2C%20Manuals%2C%20and%20Directories .For new or replacement signage follow the minimum retroreflectivity levels in SDDCTEA Pamphlet 55-14 Traffic Engineering for Better Signs and Marking, section 2.1.8 Minimum Retroreflectivity Levels, figure below.

Exhibit 2.11: FHWA's Retroreflective Sheeting Guide*

FHWA Retroreflective Sheeting Identification Guide – September 2005									
<p>Notes: ASTM Types are shown as stated by the manufacturers using ASTM D4956-04 "type designations. Agencies should verify that the sheeting they use complies with their specifications or ASTM D4956. FHWA does not endorse or approve any material no does it determine type category(s) for materials. This side of the Sheeting ID Guide is for rigid surfaces only. The other side if for flexible surfaces and non-signing applications.</p>									
Retroreflective Sheeting Materials for Rigid Sign Surfaces Made with Glass Beads									
Example of Sheeting									
ASTM Type	I	II	II	III	III	III	III	III	III
Manuvacurer(s)	note A	Avery Dennison	Nippon Carbide	3M™	ATSM, Inc.	Avery Dennison®	Kiwalite®	LG Lite	Nippon Carbide
Brand Name	Engineer Grade	Super Engineer Grade	Super Engineer Grade	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity
Series Number	Several	T-2000	15000 17000 18000	2800 3800	ASTM HI	T-5500	22000	LH8000 LH8100	N500 N800
Notes	A								
Retroreflective Sheeting Materials for Rigid Sign Surfaces Made with Prisms									
Example of Sheeting									
ASTM Type	III, IV	III, IV, X	VII, VIII, X	VIII	IV, VIII	IX	IX	X	Unassigned
Manufacturer	Avery Dennison®	3M™	3M™	Avery Dennison®	Nippon Carbide	3M™	Avery Dennison®	Nippon Carbide	3M™
Brand Name	High Intensity Prismatic	High Intensity Prismatic	Diamond Grade™ LDP	MVP Prismatic	Crystal Grade	Diamond Grade™ VIP	Omni-View™	Crystal Grade	Diamond Grade™ DG3
Series Number	T-6500	393	3970	T-7500	94000 (IV) 92000 (VIII)	3990	T-9500	93000	4000
Notes	B	B	B, D		B, C			C	
<p>A – All the manufacturers listed on the other side of this guide (except Reflexite) provide Engineer Grade sheeting. Engineer Grade sheeting is uniform without any patterns or identifying marks. Visually, it is indistinguishable from lower quality grades (i.e., utility and commercial grades).</p> <p>B – These materials can be classified as different ASTM Types.</p> <p>C – These materials are visually indistinguishable from one another.</p> <p>D – The arrow or "water mark" on this product is no longer included with new productions.</p>									

- * This exhibit is reduced about 35 percent; therefore, the sheeting examples are shown at a smaller scale.
- ** As illustrated above, Type I and II materials both have a grainy appearance similar to metallic paint, whereas all other materials have a pattern of hexagons, diamonds, or circular shapes measuring about one-eighth inch across.



1.05 AIRFIELD PAVEMENTS

Design Airfield Pavements to meet all applicable Unified Facility (UFC) and Unified Facility Guide Specifications (UFGS) requirements.

A. TECHNICAL REVIEW OF MAJOR AIRFIELD PROJECTS

All major (over \$1M) airfield pavement projects shall be reviewed by the Corps of Engineers (COE) Transportation System Center (TSC). Submittal documents at each major design review milestone shall be sent to the TSC for review. There is a fee for this service, which should be paid using project design funds. Reference AMC Policy Memo "Technical Review of Major Airfield Projects" dated 6 Feb 2002.

B. REFERENCES:

Additional Unified Facility Criteria and Engineering Technical Letter requirements exist beyond the below listed. Designers shall do a thorough code review for all applicable criteria. Airfield Designs should be to UFC and UFGS criteria not other criteria such as FAA, reference AMC Policy Memo on Design Criteria for Airfield Facilities.

1. UFC 3-260-01 - Airfield and Heliport Planning and Design
2. UFC 3-260-02 - Pavement Design For Airfields
3. AFI 32-1041 - Airfield Evaluation Program
4. AFI 32-1042 - Standards for Marking Airfields
5. ETL 04-2 - Standard Airfield Pavement Marking Schemes
6. ETL 09-6 - C-130 and C-17 Landing Zone (LZ) Dimensional, Marking, and Lighting Criteria
7. ETL 04-10 - Determining the Need for Runway Rubber Removal
8. ETL 04-4 Trenchless Technology (TT) for Crossing Air Force Pavements

C. RUBBER REMOVAL:

Rubber Removal shall be by the Chemical Detergent Method, Avion 50 or equal. Rubber removal extents shall be as determined using ETL 04-10 Determining the Need for Runway Rubber Removal

1.06 STRUCTURAL

A. UFC 1-200-01 General Building Requirements - Review this document as it is applicable to all new and renovated Government-owned facilities for the Department of Defense. Review this document for current International Building Code (IBC) adoption, and other design criteria requirements.

B. Structural Concrete.

1. Exterior concrete shall be air entrained (generally 5-7%).
2. In general, the slump should not exceed 4" unless it is being pumped (then it must be no more than 4" at point of deposit). Some types of concrete require slumps as low as 1"-2" to provide requisite characteristics (i.e. curb and gutter, etc).
3. With the exception of air entrainment, the use of other admixtures is not allowed unless approved by LRAFB and the mix design and trial batch are proportioned with the products included.

4. The mix design shall incorporate fly ash in accordance with the Affirmative Procurement requirements, unless there is a technical or economic justification for not doing so.

5. Use 4,000 psi concrete with reinforcing bars with maximum spacing of 12-inch on center for building, dock, and drive slabs supported on 3-inch cubical precast concrete blocks. Do not use WWF. Dock walls will be a minimum of 12" thick.

C. 2. Pre-engineered Metal Buildings.

1. When masonry veneer is to be incorporated into the exterior finish of a pre-engineered metal building structure, the maximum allowable drift shall be L/600.

2. Installation of overhead cranes in a pre-engineered metal building shall require a rigorous structural analysis and likely additional bracing members and heavier connections.

1.07 ROOFING

All roofing projects, including both design-build and design-bid-build, shall be designed consistent with UFC 3-110-03 Roofing, requirements of the applicable Unified Facility Guide Specifications (UFGS) (Appendix A of UFC 3-110-03 lists applicable UFGS documents), and the below LRAFB roofing requirements. To complete a design to this criteria and UFC 3-110-03 it will require the use of the Current Editions of the National Roofing Contractors Association (NRCA) *Roofing Manuals* (NRCA Manual)

<http://www.nrca.net/rp/pubstore/products.aspx?c=4> , the NRCA technical bulletins, the NRCA Construction Details, the Metal Building Manufacturers Association (MBMA) *Metal Roofing System Design Manual* (MBMA Roofing Manual)

<http://www.mbmamanual.com/Products/6-metal-roofing-systems-design-manual.aspx> .

A. ROOFING DESIGN

1. ROOFING SYSTEM DESIGN TEAM

Pending the design complexity, the roofing system design team will typically require the following Professionally Licensed / Registered Design Professionals:

- a. Roof Designer of Record, (See Paragraph Below for Roof Designer of Record requirements)
- b. Structural Engineer, PE (Required on all re-roof and new construction)
- c. Plumbing Engineer: Either a Mechanical Engineer, PE or Civil Engineer, PE (Required for low slope roof drainage calculations)
- d. Mechanical Engineer, PE, (Insulation, Ventilation, Rooftop Equipment, Fire Protection)
- e. Civil Engineer, PE
- f. Electrical Engineer, PE (lightning protection)
- g. Registered Architect, AIA

2. ROOF DESIGNER OF RECORD PROFESSIONAL QUALIFICATIONS:

The roof design including specification editing, drawings, and details shall be completed by a member of the Design Team that is a Registered Roof Consultant (RRC) or a registered PE or RA that derives his or her principal income from roofing design (Reference UFC 3-110-03, Paragraph 1-8.10). Design requirements related to the roof, but under the expertise of other members of the design team such as structural related issues shall be Designed, Stamped, and Sealed by the respective professional. The Roof Designer of Record for the

roofing system shall attend all design review meetings and present the design for the roof system. The Roof Designer of Record for the roofing system shall review all required roofing system related submittals and sign off for approval prior to Government submittal for approval. Provide the Government with contact information for the Roof Designer of Record for the roofing system to answer all Government roofing system related questions or comments as related to the roofing system for this project.

3. ROOF DESIGN AND ANALYSIS SUBMITTAL REQUIREMENTS:

Follow roofing design requirements applicable to the type of roof system being installed as detailed in this Civil Design Criteria, UFC 3-110-03, and applicable NRCA/MBMA Design Criteria as detailed in UFC 3-110-03 Paragraph 1-4.1 System Design. A full design must be complete prior to scheduling the Pre-Roofing Conference. A full design shall be submitted in drawings, details, and design analysis all of which shall be sealed and signed by the designer of record. The responsibility will be to the Roof Designer of Record to present to the Government in submittal documents and meetings how the Roofing Details included meet or exceed the minimum requirements of the required NRCA or MBMA construction details and the additional detail requirements in UFC 3-110-03. **Details shall be annotated with the NRCA and MBMA detail that they are derived from.** The Roof Designer of Record shall supplement the standard details with details required for project specific conditions and full roof system design. A complete, full design shall include the following documents submitted and Government approved:

- a. Fully edited Unified Facility Guide Specifications (UFGS) required for the roofing system and project specific conditions
- b. Roof plan and elevation drawings fully annotated with detail callouts, showing all penetrations relative to layout of the roofing system. Label with arrows the intended drainage paths of the roofing system. See section below on penetrations for additional requirements.
- c. For re-roofing projects include a roof demolition plan.
- d. Details of all flashing and components of the roofing system logically referenced to the roofing plan.
- e. UFC 3-110-03, Paragraph 1-8 and all applicable Subparagraphs, General Design Requirements
- f. UFC 3-110-03, Paragraph 1-8 .2, Wind Resistance Rating. The designer of record shall determine wind uplift pressures and dimensions of the corners, perimeter, and field of the roof in accordance with ASCE-7, Minimum Design Loads for Buildings and other Structures. Delineate calculated values in the roof specification or drawings. Utilize independently tested and rated roof systems, such as Factory Mutual (FM), Underwriters Laboratory (UL), and Single Ply Roofing Industry (SPRI).
- g. Thermal Expansion: Material Specifications and Details
- h. Ventilation Requirements calculations (applicable to attic spaces)
- i. Air and Vapor Barrier: Material Specifications and Details
- j. Fall Hazards: The Roof Designer of Record shall submit to the Government as part of the design analysis a certification that the design meets the requirements of American National Standards Institute, ANSI/ASSE Z359 Fall

Protection Code, ANSI/ASSE A1264.1 Standard and DOL - 29 CFR Part 1910, Subpart D. Include Material Specifications and Details

- k. Roof Hatches (when replacing, required by fire code, or when new attic space is created): Location, Specification, Details
- l. Skylights (only if specifically requested for a project): Location, Material Specification, Details
- m. Photovoltaic Systems (only if specifically requested for a project): Location, Material Specification, Details
- n. Insulation and Coverboard specifications, Attachment Requirements. Provide "R-Value" calculations and a drawing detail of the roofing system section with "R-Values" showing how the R-38 requirement shall be met.
- o. Tapered Insulation plan (for roofing systems in which this would be required)
- p. Penetrations, Curbs, Crickets, Flashing, Counter-flashing, Coping Cap, Gutter, Downspouts, Drains, and Scuppers: location, details, and material specifications
- q. Snow Retention Devices and Lightning Protection (applicable to metal roofing) requirements, locations, details, and specifications
- r. Positive Drainage, Drawing. Quantity, Size, Locations, and Details of Roof Drains. UFC 3-110-03 Paragraph 2-3.1
- s. Wind Design for Metal Roofs: Reference UFC 3-110-03, Paragraph 5-2.11 Wind Design, Roofing System ASTM E 1592 tested assembly
- t. Structural Analysis requirements of new and re-roofing projects
- u. In this Civil Design Criteria document see section General, B2. Sustainability, for sustainability roofing requirement submittals (applicable only to new construction for any roof system other than a SSMR)
- v. The roof system shall meet or exceed the requirements of Engineering Technical Letter (ETL) 08-13, Incorporating Sustainable Design and Development (SDD) and Facility Energy Attributes in the Air Force Construction Program, paragraph 13.11, Roofing, which states: In other than Northern Tier Installations, roofing shall meet or exceed Cool Roof Rating Council Solar Reflectance Index (SRI) of ≥ 78 for low slope roofs ($\leq 2:12$) and ≥ 29 for high-slope roofs ($> 2:12$). "Northern Tier" is defined as heating degree days (HDD) greater than 7,000 and cooling degree days (CDD) less than 2,000. . " Designers shall detail in the design analysis how this requirement is met. Submit documentation of how this paragraph will be met.
- w. Warranty Information: Warranty Information from the Manufacturer including a letter of transmittal from the roofing system manufacturer stating that their roofing system meets or exceeds all requirements
- x. Any additional applicable Roof Design Requirement listed in this document, UFC 3-110-03, NRCA/MBMA Manuals, and UFGS.

B. GENERAL ROOFING REQUIREMENTS

The below requirements are applicable to all roofing system types excepts as noted.

1. WARRANTIES

Warranties including Manufacturers and General Contractor's Workmanship warranties that require periodic inspections or repairs at the Government's expense to maintain the warranty are not permitted. The warranty terms, exclusions, and limits must be enumerated in the specifications and require that all roof curbs and penetration flashings integrated into the roof system are covered under the warranty including penetrations, flashing, counter flashing, and metal work. Roof Warranties shall be submitted for review and approval prior to material ordering. The General Contractor shall submit a letter of transmittal from the roofing system manufacturer with the roofing warranty information, stating that they have the requirements of this document and all referenced roofing requirements, and that the roof warranty is in compliance with the requirements of this document and all referenced roofing requirements. Warranties with unreasonable exclusions will be disapproved. Roof warranties shall clearly explain the warranty claim process. It is the General Contractor's responsibility to select a roofing system that meets the roofing requirements in this document, the referenced roofing requirements, the contract documents, and to ensure the roof is installed to meet all the requirements of the roof warranties. A roof warranty that allows standards of installation below the requirements of this document will not override the requirements of this document; as stated previously it is the General Contractor's responsibility to select a roofing system that will meet these requirements.

- a. Single Source Roof System Manufacturer's Minimum 20 year, Non-Prorated, No Dollar Limit, Water-Tightness and Material Finish Warranties:

The roofing system shall be provided with a fully executed Single Source Roof System Manufacturer's Minimum 20 year, Non-Prorated, No Dollar Limit, Water-Tightness and Material Finish Warranties. The manufacturer's warranties shall be from a single source manufacturer. Repairs required due to a breach in the warranties, to include material and labor, shall be covered by the warranty without any additional cost to the Government. Signatures on manufacturer's warranties will include the manufacturer, the General Contractor, and the Government representative (the contracting officer or a delegated representative). The Warranty shall be written such that the warranty will remain in affect between the manufacturer and the Government if the General Contractor goes out of business.

- b. General Contractor's Bonded 5 Year, Non-Prorated, No Dollar Limit, Water-Tightness Warranty:

The roofing system shall be provided with a fully executed General Contractor's Bonded 5 Year Non-Prorated, No Dollar Limit, Water-Tightness Warranty. Leaks during the 5 year period starting at acceptance shall be repaired by the General Contractor with no cost to the Government. This warranty shall be with the General Contractor and the Government. It shall not be acceptable for the General Contractor to pass this responsibility onto a sub-contractor. The required wording of the warranty will be provided in the applicable UFGS.

2. No asbestos containing products shall be used for any roofing application.
3. Color Selection: All color selections to be approved by LRAFB Architect. Submit all color selections for a project at one time. Submit colors in full range of manufacturer's standard colors.
4. Facility Main Entrances: For all new construction provide a gable roof for all main entrances.
5. Insulation, Ventilation, and Roof Mounted Equipment

- a. Insulation: The Designer shall design for thermal insulation requirements, ventilation requirements, and alterations to mechanical systems meeting LRAFB Mechanical Engineering Design Criteria and Expectation Guide, UFC-3-410-01FA, and ASHRAE 62 & 90.1 current standards. **Provide a thermal resistance “R” value of 38 or more.** Flexible blanket, rigid, or semi-rigid faced with a flexible vapor retarder. Vapor retarder shall be an ice/water guard membrane underlayment. Insulation and facing shall have a flame spread rating of 50 or less in accordance with ASTM E 84. Vapor retarder facing shall have a permeance rating of 0.05 perm or less.
- b. Ventilation (applicable to attic spaces): The designer shall design to meet ventilation requirements. For gabled and hipped roofs, ventilation shall be provided to furnish cross ventilation of each separate attic space with weather tight vents. Louvers shall be pre-manufactured minimum 4 inch deep, driven-rain tight. Provide drawing details and submittals for louvers. Vents that leak shall be fixed or replaced by the contractor with no additional cost to the Government. All vents shall be screened to protect the interior from intrusion of birds and insects. All calculations determining the appropriate ventilation requirements for proper air exchange shall be provided by the design team’s mechanical engineer, not by the manufacturer of the roof assembly. The ratio of total net free ventilating area to the area of the ceiling shall be not less than 1/150. That ratio may be reduced to 1/300 provided:
 - i. A vapor retarder having a permeance not exceeding one perm is installed on the warm side of the ceiling
 - ii. At least 50% of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated (at least 3 feet above eave or cornice vents) with the balance of the required ventilation provided by eave or cornice vents
- c. All roof mounted equipment devices (roof mounted HVAC units, pipes and pipe supports and other equipment) associated with roof assembly shall be designed, installed, and fastened securely to meet high velocity wind loading set forth for the local geographical area.
- d. Ensure all roof top equipment has sufficient taper to crickets to allow water to flow around said equipment and away from flashings. Install crickets at all equipment, chimneys and penthouses 24 inches or wider. Crickets are also required at wall and pitch change interfaces that may pond water. Install extra layers of membrane around roof penetrations to ensure no ponding and water is run around penetrations.

6. Underlayment: Steep slope roofs with a solid substrate shall have an underlayment. Underlayment shall be 55 mil, mineral surfaced, fiberglass reinforced, flexible SBS modified asphalt “Peel& Stick, Moisture Guard Plus” or equivalent over the entire roof system to include all valleys, and hips for all shingle or standing seam metal roof systems. Underlayment shall extend up and over roof curbs.

7. Curb Heights and Crickets: For all slope roofs provide crickets on the up-slope side of all non-round penetrations. Curbs shall be a minimum of 8 in. above the roof surface, but shall not be less than 6 in. above the high point of a cricket.

8. Penetrations:

- a. Designers shall minimize roof penetrations.
- b. Designers shall provide a plan showing all rooftop equipment. Designers shall identify rooftop equipment no longer in use, and shall detail the removal of such equipment. Designers shall provide details and specifications on the contract documents detailing the repair of the roof system at the removed equipment.
- c. Designers shall design and provide construction plans and specification (including demolition plans) for relocation of all mechanical, electrical, and communication equipment that must be removed from the existing roof.
- d. Extend all penetrations to remain above the roof line. Provide drawing details for each type of penetration. The designer is responsible for coordinating the penetration location in order to avoid an installation that would cause problems with the roofs system, such as interrupt the panel seams on SSMR. Weatherproof characteristics and independent movement must be accounted for by the designer at all penetrations. All penetration shall be installed per the roofing system manufacturer's requirements for 20 year water-tightness warranty.
- e. Water shall not be trapped at curbs. Provide crickets made of the same metal type and gauge as the metal panel or change the orientation of the roof curb so that it allows water to flow around it. Curb flange must underlay roof panels at the upslope detail and overlay panels at the down slope detail. Panel seams must terminate well before the curb wall and use built-in diverters to prevent ponding at curb wall.
- f. On metal roofs flash small, round penetrations with pre-manufactured EPDM black rubber boots having a laminated aluminum compression ring at their base and secure at the top using a stainless steel draw band; application may not interrupt a seam location, and the EPDM membrane shall be protected from exposure using a 24 gauge PVDF on galvalume shroud flashing matching the color of the roof system.
- g. For shingle and BUR roofs design to install lead jackets on all roof plumbing vents.

9. Flashing, Counter-flashing

- a. Details shall be provided on the drawings for all locations requiring flashing, valleys, hips, ridges, penetrations, roof & wall intersections, gutters, and downspouts.
- b. All flashings shall be tight to receiving components (walls, base flashings, roof flashings, counter flashings) without fillers. Fillers on metal roof seams and laps to associated materials are acceptable with approved two sided tapes and sealants.
- c. All valleys, ridges, eaves, rakes, dormers, penetrations, and flashing shall be designed and detailed to resist blowing rain.
- d. Flashing shall be installed at all roof to wall intersections, at gutters, eaves, rakes, curbs, penetrations, and wherever there is a change in roof slope direction.

- e. Install pre-finished 22 gauge 70% PVDF on galvalume on steel for all soffit, fascia, drip edge on all eaves and rakes, box-gutters, downspouts, flashing and counter-flashing. Flashings will be of like materials. If dissimilar materials are in contact with one another from existing or previous work, then special protection procedures must taken to eliminate corrosion and/or the effects of non-uniform thermal expansion and contraction
- f. Gravel stops shall be a pre-finished 18-gauge PVDF on galvalume on steel.
- g. Flashing and counter-flashing for steep slope roofing applications shall be stepped flashing meeting the detail requirements of NRCA.
- h. At walls the counter-flashing shall be installed in a reglet. Where practical counter-flashing shall extend all the way up adjoining walls.
- i. Ensure all counter flashings are secured properly into all walls, curbs, rooftop units and coverage at a minimum height of three (3) inches below the lowest fastener or top edge of base flashing material.

10. Coping: Coping systems shall have a minimum FM 1-90 wind rating. Coping shall be cleated on two sides with concealed clips or fasteners meeting NRCA detail requirements. Provide slope for all coping caps and all horizontal projections of transitions. A minimum 55 mil ice and water shield membrane shall completely lap the parapet wall from edge to edge under the coping. Coping systems shall be included in the roofing system manufacturer's 20 year NDL watertight warranty.

11. Gutter, Downspouts, Scuppers and Drain Systems: Gutter and downspouts shall tie into the base storm water system. Provide details on drawings for gutters, downspouts, connections, and connection to the base storm water system.

- a. All gutters, drains, and scuppers shall be designed to carry the maximum water flow for water removal, and ability to hold weight of water when full.
- b. Prepare calculations to determine the minimum drainage requirement using the calculation method as specified in the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) Architectural Sheet Metal Manual (current edition). Obtain the rainfall component for the project site from UFC 3-400-02, "Design: Engineering Weather Data". Locate downspouts, scuppers, and leaders to preclude water and ice build-up on pedestrian paths.
- c. Provide calculations showing minimum sizes of gutters, downspouts, scuppers (low slope roofs), and piping to base storm water system.
- d. Install cast iron downspout boots/shoes with brass cleanout to protect lower portions of each down spout from grounds maintenance high speed mower impacts. Downspout shoes shall be Neenah Foundry R-4929 with Cleanout or approved equal. Boots shall be provided with a powdercoat finish as selected by the LRAFB Architect.
<http://www.nfco.com/municipal/products/downspout-shoes/>
- e. At all gutter locations that tie into underground drainage lines provide combination drain basin/cleanout with a concrete collar and hinged ductile iron grate meeting ASTM A-48-83 Class 30B. Gutter shall tie directly into the drain pipe. Drain basin shall be Nyloplast or equal.

- f. Drain pipe shall be minimum 10" for maintenance purposes. Drain pipe shall meet minimum requirements of ADS N-12 Dual Walled HDPE Pipe or equal. Meet pipe manufacturer's minimum recommendations for installation to include cover, bedding, etc. Where possible drain pipe shall tie into drop inlets or manholes. Use non-shrink grout or pipe manufacturer's recommendations.
- g. The standard for design-build and design-bid-build projects will be that the gutters tie into the base storm water system through underground piping. The exception to this is detailed in the below paragraph "Splash Blocks"
- h. Splash Blocks: On downspouts where the base storm water system or open channels are not within 50' of the building where the downspout will transition to piping and where installing piping would require a utility cut through existing pavement, as long as there is positive drainage away from the facility (positive drainage as defined by UFC 3-210-06a Figure 4-16) with approval of the LRAFB Project Engineer, the Designer shall detail and specify a minimum of 185 pound, 5" x 12" x 60" concrete splash block at the approved downspout location instead of tying into the storm water system. Splash block may also be fiber reinforced 6" x 24" x 60" cast-in-place 3500 psi concrete pads.
- i. On Design-Bid- Build projects if an existing roof system does not tie into the base storm water system the design team shall provide a detailed cost analysis to be used to determine if it is economically responsible to tie the roof system into the base storm water system, or if splash blocks should be the preferred method. The design team will provide a design recommendation as to which downspouts should have splash blocks, and which downspouts shall tie into the base storm water system.
- j. For re-roof projects and for new construction of low slope roofs consult a plumbing engineer to determine the appropriate number of roof drains and the size of the drainpipe. (Reference UFC 3-110-03, Paragraph 2-3.1 and 6-4.4).
- k. Low slope roofs shall have primary drains and overflow drains for each roof section in size and quantity to each individually handle the design flows.
- l. When re-roofing, do not diminish the size of, nor reduce in count the drains, scuppers or outlets. All size changes must be carefully designed to provide ample drainage and flow based on local rain fall rates. Verify that all overflow drain heights are adequate, and are not functioning as a main drain.
- m. Clean debris from all clogged roof drains, scuppers, gutters, and downspouts to remain.
- n. Protect all drains from construction debris and clogging. Cover all drains prior to beginning tear off. Verify all drains are open, functioning and free of debris before work commences. Contractor will be responsible for correcting all plugged and inoperable drains at the completion and testing of drains for final commissioning
- o. Drains must remain functioning thru out the construction process or provide alternative method of draining water in the event of rain.
- p. Performance testing of drains shall be required on all new and repaired drains at final commissioning. The test method shall be to plug the drains with air expandable test ball and flood roof areas around drains, visually inspect the

underside of the drains, and then observe the flow and evacuation of the water when the plug is removed. Any leaks experienced around the drain, may require the total replacement of the drain assembly.

- q. All drains shall be set in lead or other approved flashing materials recommend by manufacture. Replace all damaged rings: damaged rings noted as cracked, broken, and heavily rusted to prevent water tight seal. Repaint all rings prior to reinstalling. Replace all drain bolts and install new drain bolts in anti seizing compound. Replace all damaged, missing and covers that are of incorrect size .Repaint the remainder of drain covers with two coats of rust inhibitive industrial enamel paint.
- r. Install crickets in between all drains, scuppers and over flow drains and scuppers to insure no ponding of water.

12. Fall Protection: All roofs with a slope greater than 3:12 shall have permanently installed certified anchorages (hard points) in adequate quantity to allow for safe maintenance on the entire roof system utilizing fall arrest equipment. Installed fall protection systems shall be compatible with 19 CES Structures on hand equipment, and not require purchase of additional safety equipment. Meet the requirements of UFC 3-110-03, Paragraph 1-8.5. The Roof Designer of Record shall submit to the Government as part of the design analysis a certification that the design meets the requirements of American National Standards Institute, ANSI/ASSE Z359 Fall Protection Code, ANSI/ASSE A1264.1 Standard and DOL - 29 CFR Part 1910, Subpart D.

13. Roofing Quality Control:

Reference UFC 3-110-03 Roofing, Appendix E, Quality Assurance Considerations.

- a. Roofing Quality Controller: It shall be required that during construction a Registered Roof Observer (RRO) or Registered Roof Consultant (RRC) or a registered PE or RA that derives his or her principal income from roofing design shall perform full time construction inspection services for all roofing phases to ensure a quality roof installation and compliance with contract Specifications and Drawings. Daily inspections sheets and punch lists generated by the Roofing Quality Controller shall be supplied to the Government Inspector and Contractor daily.
- b. Specifications shall require complete shop drawing submittals. Shop drawings shall be approved by the Roof Designer of Record prior to submittal to the Government. If the Roof Designer of Record is not available the Roofing Quality Controller shall review and compare with Contract Drawings & Specifications for approval prior to submittal to the Government. The roofing Quality Controller shall be provided by the General Contractor all approved submittals for verification on the job site.
- c. It shall be specified that the roof manufacturer's representative inspect the roof a minimum of three times during installation in the presence of a Government Construction Inspector. The three inspections shall be in the beginning, middle, and end of construction.
- d. If leaks exist before close-out of the project, the roof shall not be accepted. Leaks shall be properly rectified and retested for leaks prior to acceptance.

14. Minimum Installer Qualifications:

Submit minimum installer qualifications to the Contracting Officer. Minimum installer qualifications shall include the following (Reference UFC 3-110-03, Paragraph E-3.7):

- a. Proof of at least three years of membership in a professional or trade roofing-related organization such as NRCA, RCI, a state Roofing Contractors Association, or SMACNA.
- b. Documented five years of experience and five jobs of similar complexity
- c. Proof of certification by the manufacture that the installer is qualified to install the roofing system specified.

15. Pre-Roofing Conference:

Following the approval of the roofing system design and submittals by the Government, but before performing roofing system installation or demolition work, hold a prerooting conference.

- a. The Contractor shall coordinate the pre-roofing conference scheduling with the Contracting Officer.
- b. Attendance at the pre-roofing conference is mandatory for all key players including:
 - i. Contracting Officer
 - ii. Government Inspector,
 - iii. Government Project Engineer responsible for the roofing system design approval,
 - iv. If available, 19th CES Structures Shop Maintenance Personnel
 - v. Roof Designer of Record for the roof system,
 - vi. Roofing Quality Controller,
 - vii. Roof System Manufacturer,
 - viii. General Contractor,
 - ix. Roof Contractor/Installer,
 - x. Representatives from all trades whose work impinges upon the roof system: plumbing, HVAC, carpentry, masonry, steel deck erectors.
- c. Before beginning roofing work, the Contractor shall provide a copy of meeting notes and action items to all attending parties. Included in the meeting notes the Contractor shall delineate how each action item requiring resolution was resolved.
- d. At a minimum, the Contractor shall present the following at the pre-roofing conference:
 - i. Drawings, Details, Specifications, and approved Submittals related to the roof work
 - ii. Roof system component installation
 - iii. Procedures for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing system, the name of the manufacturer's technical representative, the frequency of onsite visits, and

distribution of copies of the inspection reports from the manufacturer's technical representative to roof manufacturer.

- iv. Design Build Firm's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing.
- v. Quality Control plan for the roof system installation
- vi. Safety requirements

16. ROOF INFORMATION CARD

Per the UFGSs for each roof installation, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point.

C. LRAFB STANDARD ROOFING SYSTEM TYPES:

The below roofing system types are the standard roofing types for LRAFB. All other roof types require LRAFB, and potentially MAJCOM and/or Air Force Roofing Subject Matter Expert approval prior to selection and installation. The below roofing systems will be used for new construction, roof replacement, metal roofing retrofit (hat system), and metal roofing overbuild (roof-slope conversion) projects; reference UFC 3-110-03, Paragraph 6-2.1 for terminology.

1. HYDROSTATIC (WATERTIGHT) STANDING SEAM METAL ROOFS:

The LRAFB standard roofing for new construction is a sloped hydrostatic standing seam metal roof. Reference AMC Roof Policy dated 22 July 2002. Sloped hydrostatic standing seam metal roof will also be used for metal roofing retrofit and metal roofing overbuild projects.

- a. Regardless of the prescribed or existing slope, all standing seam metal roofs on LRAFB shall be hydrostatic (watertight).
- b. Slope: The preferred slope is 4 to 6 on 12.
- c. Panel Type, Coating, and Thickness: Panel type shall meet architectural compatibility, and wind uplift performance requirements. Panels shall be factory fabricated from hot dipped steel coil coated with 55% by weight aluminum-zinc alloy (such as galvalume) in application rate of .55 oz minimum per square foot, with an exterior finish of 70% polyvinylidene fluoride (such as KYNAR 500) containing 100% inorganic pigments. Minimum thickness shall be 22 gauge to improve aesthetics with respect to oil canning (Reference UFC 3-110-03, Paragraph 5-2.7), and the minimum panel material thickness must be consistent with the material thickness as it was tested for structural capacity in ASTM E1592 Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- d. Seam Configuration: Shall be 180-degree, double fold; unless wind uplift design considerations or architectural compatibility dictate a requirement otherwise supported by design analysis of the Roof Designer of Record and LRAFB approval.
- e. Panel Attachment: The SSMR system shall have concealed articulating fasteners and be continuously mechanically seamed. Clips must be "wetted" to the male seam component with butyl sealant to ensure complete

hydrostatic performance of the joint and as required by ASTM E2140. Reference UFC 3-110-03, Paragraph 5-2.8 for additional requirements including requirements for the fixed point.

- f. Exposed Fasteners: (Reference UFC 3-110-03, Paragraph 5-2.8.2) Minimize the use of fasteners that penetrate the weathering surface of the roof panels and flashings. Use these fasteners in panels only at end-to-end joining and at the lower termination point (point of fixity) of the panel. Fastening through the flat of the roof panel in the ridge or hip areas shall be concealed behind rib closures and under flashings. Sealing washers shall be EPDM (not neoprene) to improve durability and service life. When fastening sheet-to-sheet, backup plates are required to stiffen the joint and provide solid attachment for screws.
- g. Seam Sealant: (Reference UFC 3-110-03, Paragraph 5-3.3.3) Each seam must have a factory applied, pre-applied bead of non-curing, non-hardening polyisobutylene-isoprene copolymer or terpolymer (butyl) sealant to ensure hydrostatic performance. Continuity of seal with field applications through all panel termination points is critical. Silicone sealant is not allowed. Primary seals must always be concealed within a joint. When secondary seals are used, they may be exposed one-part polyurethane.
- h. Overhangs: The roof deck and the roof panels shall extend 24" beyond the exterior wall. Dormers shall have a minimum 1' overhang.
- i. ASTM Test Method: (Reference UFC 3-110-03, Paragraph 5-3.5) Hydrostatic joint performance shall be tested per ASTM E2140, Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head. The test normally tests only the panel side and end-joints, but it can be adapted to test other assemblies also. In addition to the standard standing seam testing, test the eave of the metal roof system.
- j. Required Hydrostatic Construction Details: (Reference UFC 3-110-03, Paragraph 5-3.7) Regardless of actual project slope, use the "Vertical Rib Low-slope Details" (2-1 through 2-30) in the MBMA Roofing Manual, as applicable, as the basis for the design and detailing principals. Do not use NRCA or SMACNA details for hydrostatic metal roofing.
- k. Flashing and Penetrations:
 - i. Utilize the same factory finished material as roof panels for all exposed flashings and shrouds.
 - ii. Concealed sealants must be non-curing polyisobutylene tapes, supplemented with butyl tube grade when necessary to improve flow characteristics into crevices and other difficult areas. These compounds shall be sandwiched between joint components, in concealed locations, and not exposed. Curing compounds are not permitted. Exposed sealants are to be high-grade polyurethane matching the color of the roofing system.
 - iii. All flashings at vertical surfaces shall be integrated and coordinated with the throughwall flashing to assure water tightness and drainage. A water resistant membrane shall be incorporated into the flashing detail to prevent moisture intrusion from wind driven rain and water from ice damming.
 - iv. Flash small, round penetrations with pre-manufactured EPDM black rubber boots having a laminated aluminum compression ring at their base and

secured at the top using a stainless steel draw band; application may not interrupt a seam location, and the EPDM membrane shall be protected from exposure using a 24 gauge PVDF on galvalume shroud flashing matching the color of the roof system.

- I. Snow Retention Devices: Snow retention devices shall be provided to protect critical equipment located on the roof, and above all pedestrian and vehicular traffic entrances. Snow retention devices shall be non-corrosive, non-penetrating, and mechanically attached with convex setscrews to the standing seams and penetrations and roof curbs. Select snow retention devices to resist all in-service loads considering roof slope and design snow load. Prove adequacy on a site-specific basis by calculation and lab-tested holding strengths of devices. Snow retention devices that glue to panel surfaces or use attachments that penetrate roof panels are prohibited. Snow retention devices that void material and coating warranties shall not be used.
- m. Lightning Protection: The Designer shall specify lightning protection meeting requirements of UFC 3-110-03, paragraph 5-2.10.2.
- n. Wind Design: (Reference UFC 3-110-03, Paragraph 5-2.11) In submittals provide a roof assembly which has been tested in accordance with ASTM E1592; and the roof manufacturer's technical staff will provide the necessary clip spacing based on the ASTM E1592 test results. The metal roof assembly shall replicate the ASTM E1592 tested assembly with respect to clip type, gauge, spacing, and attachment. Because the ASTM E1592 test is conducted with attachment to heavy gauge purlins, the actual construction assembly needs to match the pullout resistance of the tested assembly but may attach to a steel deck or other structural element. The ASTM E1592 tested assembly and the structural performance characteristics must be used when performing the ASCE 7 wind uplift calculations.
 - i. The maximum clip spacing for metal roof assemblies shall be 60 in. on-center in the field and 30 in. on center in the perimeter and corner zones.
 - ii. Install a minimum 16 ga bent steel plate at all eave, rake, and ridge edges of a metal roof assembly for roof attachment. Wood blocking (treated or untreated) shall not be used in metal roof assemblies.
- o. Leakage Tests - Finished installations of metal roofing shall to be subject to inspection and tested for leakage by a third party and an Architect/Engineer. Inspection and tests will be conducted at the cost of the installing contractor and no cost to the Government. Where retesting is required due to leaks experienced and repaired, the leak re-test will be at the cost of the contractor.
- p. Warranties: The roofing system shall be provided with the above mentioned roof warranties.

2. STEEP SLOPE ROOFING, SHINGLE ROOFS:

For shingle roof projects, install 340+ lb/square, 40 year (lifetime) multi-layer architectural shingle. Shingles shall be held down with roofing nails and stick tabs only; no staples. Shingles shall also have a minimum wind rating of 90 miles per hour without any special nailing or adhesive procedures. Valleys are to be woven style, provide NRCA detail in contract drawings. Underlayment shall be 55 mil, mineral surfaced, fiberglass reinforced, flexible SBS modified asphalt "Peel& Stick, Moisture Guard Plus" or equivalent over the

entire roof system to include all valleys, and hips for all shingle or standing seam metal roof systems.

- a. Overhangs: The roof deck and the roof panels shall extend 24" beyond the exterior wall. Dormers shall have a minimum 1' overhang
- b. Perimeter Drip Edge: Perimeter drip edge is required. Drip edge shall be pre-finished 24 gauge 70% PVDF on galvalume on steel. Drip edge shall be installed with a continuous cleat. shall
- c. Warranties: The roofing system shall be provided with the above mentioned roof warranties.

3. LOW SLOPE ROOFS: AGGREGATE SURFACE, 4 PLY BUR OR MODIFIED BITUMEN CAPSHEET ON TOP OF A 4-PLY BUR (ADDED 22 FEB 2013)

Aggregate Surface, 4 ply BUR is the LRAFB standard low slope roofing system. Where the existing roof decking does not slope, tapered insulation shall be installed to the extent possible to achieve a minimum ½ inch on 12 slope. Roof curb heights shall be a minimum of 8 inches above the finished roof surface. Fully adhered roof walk pads, spaced to allow proper drainage, installed per manufacture's recommendations shall be installed to all rooftop equipment to remain from the roof access point. A 4 ply BUR with a Modified Bitumen Capsheet may also be used (added 22 FEB 2013).

- a. Membranes shall be laid as continuously as possible. Install all penetrations, nailers, curbs prior to installing membrane roofing materials.
- b. Low slope roofs shall require plies be installed so that the flow of water runoff will not be against (or in the direction of) the laps.
- c. Low slope roofs shall have primary drains and overflow drains for each roof section in size and quantity to each individually handle the plumbing engineers design flows.
- d. If scuppers are used for the overflow drains the designer shall include scuppers 2-3" above the level of the primary drains, properly sized and spaced to handle the same flow as the primary drains in case the primary drains on a flat roof are blocked. Include NRCA detail in contract drawings, and specify location on roof plan. Include the "L" shaped gravel guard secured to the scupper flange notched to permit drainage. Scuppers shall include metal conductor head and downspouts.
- e. Deck Type and Insulation Attachment: Reference UFC 3-110-03, Paragraph 2-4.2 for insulation attachment requirements.
 - i. The ideal method of attachment is a mechanically attached first layer (metal decks) with subsequent layers installed using hot asphalt or adhesives. Simultaneous attachment of all layers may be used in cold process and single ply applications. Engineered high wind area zone calculations will take precedence over this standard.
 - ii. ISO board insulation must be installed in multilayered staggered joints. Joints shall be staggered minimum of six (6) inches at all end and lap joints. When installing with hot asphalt no pieces larger than 4' by 4' ft can be used. When mechanically attached 4' by 8' sheets can be utilized. No pieces smaller than 2' by 4' can be used and they must be discarded immediately. Stagger must be maintained at all night time dry in and cut offs.

- f. Coverboard: A coverboard is required directly below the roof membrane.
- g. Cant strips are required
- h. Expansion Joints: Where applicable, designer shall include expansion joints. Place at high points with drainage directed away. Specify where deck material changes, for example from concrete to steel. Specify where the span of the deck changes direction. Specify at a maximum spacing of 150 to 300 feet. Include NRCA detail in contract drawings, and specify location on roof plan.
- i. BUR must use fiberglass mat material.
- j. Membrane Flashing
 - i. Membrane flashing material shall be applied tight to the wall and be totally free from wrinkles, air pockets and blisters. Ensure asphalt temperatures will facilitate proper installation of membranes without above conditions and pooling of asphalt behind membranes.
 - ii. Membrane flashing shall be terminated with a mechanical fastening system separate from the metal flashing and counter flashing. Fastening system will be sealed and covered with approved sealants and membranes.
 - iii. Membrane shall be a minimum of eight (8) inches above the finished roof height and terminated to within two (2) inches of the top of membrane. The membrane shall be a minimum of five (5) inches above top of any cant strip or change in slope or direction.
 - iv. Base sheets shall always be used under all flashing membranes in the same manner as the roof membrane and base sheets. The base sheets shall cover cant strips.
 - v. Membrane flashing adhesives will be applied with proper tools (trowels, knives, paddles, mops etc.) and per the recommendations from the product manufacturer as required to maintain uniform and even thickness of adhesives and cements.
- k. Walk pads: place walk pads from the roof hatch entrance to all rooftop equipment as specified in the applicable UFGS. Minimum thickness shall be 200 mils. Install walk pads prior to installing gravel. Insure they are installed above the aggregate height.
- l. Aggregate Surface: The aggregate surface shall be embedded in a bituminous flood coat or a manufacturer's adhesive designed for the use of embedding aggregate surface to BUR to aid in solar reflectance. The thickness shall be 400 lb of gravel surfacing per square of roofing which is .5 to .75 inches thick. Aggregate surfaced roof system coverings shall be designed and installed in accordance with the IBC Code and Table 1504.4 based on the exposure category and basic wind speed at the building site.
- m. Warranties: The roofing system shall be provided with the above mentioned roof warranties.

D. RE-ROOF PROJECTS:

The LRAFB Standard Roofing System types will be used for re-roof projects. Re-roof projects include roof replacement, metal roofing retrofit (hat system), and metal roofing

overbuild (roof-slope conversion) projects; reference UFC 3-110-03, Paragraph 6-2.1 for terminology. Reference UFC 3-110-03 Chapter 6.

1. Facilities shall remain weatherproof during construction.
2. Re-roof projects shall repair by replacement, retrofit, or overbuild all components of the roofing system including coping, flashing, counter-flashing, edge metal, gutters, downspouts, scuppers, and insulation.
3. All decks shall be inspected and repaired to accept new roofing system. Repairs shall not affect the levelness of the insulation boards cover boards taper system or other components of the roof system. Use >5% of deck surface for replacement in base bid unless the Statement of Work explicitly lists otherwise. Provide the cost per square foot to replace damaged deck surface with your proposal. The cost per square foot will be used for a modification if quantities of repair required go over 5%.
 - a. Concrete deck damage is considered but not limited to: thermal cracks, settling cracks, alkali- aggregate reactions causing spalling and cracking, corrosion cracking, spalling and swelling, d-cracking, detached crazing, unlevel, deflection, sagging, dips and fault lines. All repairs shall be made to ensure proper adhesion, application and drainage of roof system. Provide documentation of moisture content (by moisture meter) or hot asphalt bubble test, prior to installing materials .Document with photo verification.
 - b. Metal deck damage is considered but not limited to; scaled, or delaminated rusted areas, peeling paint, blistering and un-adhered paints and finishes, unfastened metal panels, bent or buckled metal panels, deflection, sagging dips and areas that would prevent proper adhesion or bonding. Rust repair shall include wire brushing, sanding, scrapping, sand blasting and preparing for proper application of rust inhibiting paints and coatings. Apply a minimum of two even coats of corrosion inhibiting finishes allowing ample curing time (prescribed by the paint manufacturer) between coats.
4. Identify existing rooftop equipment that is no longer in use. Verify all equipment to remain is functioning. Protect all equipment to remain from construction damage. Remove and reinstall equipment to remain as required to install the new roof system. Reinstallation shall be as required to meet manufacturers warranty requirements and design criteria requirements of this document. Remove all abandoned rooftop equipment including curbs and replace decking.
5. Designer shall incorporate safety requirements into the roofing project drawing and specifications. Safety is of paramount importance. Protect occupants from fumes by coordinating the shut down of air handling units. Protect occupants in areas where roofing work is taking place directly overhead by directly cordoning off the area, especially if deck repairs are taking place. Protect all occupants entering or leaving the building from falling materials. Identify the location of underground tanks and other sensitive, sub-surface items so that heavy vehicles do not overload these areas.
6. LOW SLOPE ROOFING REPLACEMENTS:
 - a. Reference UFC 3-110-03 Paragraph 6-4.1. Provide an analysis of the existing structure and the proposed roofing system by a Licensed Structural Engineer. Submit the signed and stamped analysis that certifies the existing structure is adequate to safely support the proposed roofing system and current requirements of ASCE 7. Include in the analysis the assumed loads of

the new roofing system. As-Built or historical documents may not be available, and the design team should plan accordingly. All As-Built and Historical documents available shall be provided.

- b. Reference UFC 3-110-03, paragraph 6-4.4. For re-roof projects install additional roof drains as required by the plumbing engineer flow calculations; this shall be included in the base bid for the project. Low slope roofs shall have primary drains and overflow drains for each roof section in size and quantity to each individually handle the plumbing engineers design flows. Overflow drains shall be 2-3" above the primary drains. Overflow drains in the form of scuppers shall be acceptable for all sections of roof that do not have an overflow drain. Include the "L" shaped gravel guard secured to the scupper flange notched to permit drainage. Scuppers shall include metal conductor head and downspouts. Provide details of new drains and plan drawings showing the locations. Submit the plumbing engineer's stamped and signed design analysis for the drains detailing the quantity, size, code requirements, and calculations. New drains shall meet architectural compatibility requirements. New required drains shall be covered by the roofing system manufacturer's 20 year watertight warranty.

7. METAL ROOFING RETROFIT (HAT SYSTEM):

Reference UFC 3-110-03 Paragraph 6-9.1. Provide an analysis of the existing structure and the proposed roofing system including a structural evaluation of the proposed framing system and the attached roof panels by a Licensed Structural Engineer. Submit the signed and stamped analysis that certifies the existing structure is adequate to safely support the proposed roofing system and current requirements of ASCE 7. Include in the analysis the assumed loads of the new roofing system. As-Built or historical documents may not be available, and the design team should plan accordingly. All As-Built and Historical documents available shall be provided.

8. METAL ROOFING OVERBUILD (ROOF SLOPE CONVERSION):

Reference UFC 3-110-03 Paragraph 6-9.2

- a. Provide an analysis of the existing structure and the proposed roofing system including a structural evaluation of the proposed framing system and the attached roof panels by a Licensed Structural Engineer. Submit the signed and stamped analysis that certifies the existing structure is adequate to safely support the proposed roofing system and current requirements of ASCE 7. Include in the analysis the assumed loads of the new roofing system. As-Built or historical documents may not be available, and the design team should plan accordingly. All As-Built and Historical documents available shall be provided.
- b. Remove the existing roof system down to the decking. Replace damaged decking.
- c. Provide attic access to the newly created attic space.
- d. Provide ventilation design requirements for the new attic space.
- e. The Designer shall provide a permanent lighted catwalk from the roof access to mechanical equipment to remain in the design of the attic space. For existing metal and concrete decks the designer shall provide heat detectors in the design of the attic space. Heat detectors shall connect to the fire alarm

panel. For existing wood decks the designer shall provide a dry pipe fire protection system. The roof design shall provide adequate access for maintenance and removal of all mechanical, electrical, and communication equipment designed to be left in place on the existing roof.

- f. Designer shall detail how to meet the fire hazard concerns of the newly created attic space will be addressed. Include all requirements.
- g. Designer shall detail how the ventilation concerns shall be addressed. Include all requirements.
- h. Designers shall specifically address how they will deal with penetrations of new framing connections through the old roof and maintain adequate drainage of the old roof during the construction period.
- i. Overhangs: The roof deck and the roof panels shall extend 24" beyond the exterior wall. Dormers shall have a minimum 1' overhang
- j. Shop Drawing Review: Prior to submittal to the Government the Roof Designer of Record shall approve the shop drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION – 19th CES CIVIL/STRUCTURAL DESIGN CRITERIA AND EXPECTATIONS

