SODIV-TG-1005
February 1996

TECHNICAL GUIDANCE

FOR

CIVIL DESIGN

Prepared By:

CIVIL DIVISION
PLANNING AND DESIGN DEPARTMENT
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

SODIV-TG-1005

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

1. INTENT: The purpose of this document is to provide technical guidance and outline technical requirements for the more typical aspects of the civil design portion of Architect/Engineer (A/E) contracts for Southern Division, Naval Facilities Engineering Command. The information provided in this guide shall be utilized by civil designers in the development of their portion of the plans, specifications and calculations and shall serve as minimal civil design guidance. This is a guide only and is not intended to cover every situation or restrict innovative design alternatives and good common sense design decisions. Questions or recommendations for improvement of this document should be brought to the attention of SOUTHNAVFACENGCOM, Code 0753 (Will Beverly at DSN 583-7352 or commercial (803) 820-7352).

2. GUIDANCE AND CRITERIA: For further guidance and sources of criteria refer to the latest revision of:

a. "Statement of Work" for the particular A/E contract
b. SOUTHNAVFACENGCOM P-141, "GUIDE FOR ARCHITECT-ENGINEER FIRMS PERFORMING SERVICES FOR THE SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND"
c. "SOUTHNAVFACENGCOM INDEX OF CRITERIA" - Includes guide specifications, Design Manuals, Military Handbooks and various military publications
d. "SOUTHNAVFACENGCOM INDEX OF AIR FORCE CRITERIA" - (Note: Use for Air Force Projects only)
e. Division 02 Guide Specifications (particularly the guide or criteria notes accompanying the guide specification sections)
f. Local regulatory or permitting agency manuals for guidance concerning preparation of permits (stormwater, sanitary, etc.)
g. "Parking Area Criteria For Vehicles" (NAVFAC Drawing Number 1404837)
h. Contact the Activity concerning site specific issues and user requirements. This contact is particularly important in projects that involve Physical Security applications.
i. Department of Transportation Standard Specifications for Roads and Bridges for the State where the project is located
j. "General Requirements For Shorebased Airfield Marking And Lighting" (NAVAIR 51-50AAA-2)

SECTION 2

SITE DEVELOPMENT

1. SITE LAYOUT: The site layout should satisfy the functional and operational requirements of the new facility. Depending on the scope of the project, the layout should be approached from an interdisciplinary viewpoint to ensure proper coordination of the final design. As a minimum, the layout should integrate the new construction into the context of the site and surrounding base environment so that consideration is given to the following:

a. Existing traffic patterns are not adversely affected
b. Utility and storm drain runs are minimized
c. Setback requirements are in compliance with respect to property lines, applicable codes and security
d. Security requirements are implemented, particularly where security fencing and associated inside and outside security clear zones are involved
e. Tree removal is kept to a minimum
f. Natural topographic features are preserved to the best extent possible to minimize cut and fill
g. Aesthetic relationships are balanced
h. Maintenance costs are kept minimal
i. Phasing, scheduling and constructability issues are considered, particularly where existing security fencing is being removed and installation of new security fencing must be delayed due to other site preparation work
j. Solar impact versus facility orientation

1.1 SITE ANALYSIS: Prior to the actual site layout, the site must be evaluated with respect to two important factors:

a. The opportunities and constraints of the site in relation to the proposed development (factors such as elevation, environmental contamination, soil types, water table elevation, stormwater management, flood zone, etc.)
b. The impact upon the Activity at large, especially the immediate adjacent areas

1.1.1 A preliminary site visit should be conducted. Photographs of the site and existing as-built record drawings should be obtained (if available) which may provide general topographic information, utility and stormwater drainage availability and soil boring log information near the site. Secondly, detailed consultations with the user should be accomplished in order to clearly define requirements and preferences. The above information should then be assessed to determine the preliminary configuration and location of the major site elements (building location and

orientation, parking areas, stormwater detention facilities, and access and egress to the site). The results of the above analysis should then be presented to the user for review, preferably before any actual surveys or subsurface explorations are accomplished.

1.2 SUBSURFACE EXPLORATION: The A/E shall be responsible for obtaining all necessary soils exploration and testing. A local geotechnical consultant is strongly recommended. The amount of exploration and testing should be determined based on discussions with the geotechnical consultant, structural engineer, civil engineer, and local stormwater permitting agency (double-ring infiltrometer test may be required at detention pond locations). Additionally, if the site is known to have environmental contamination, the appropriate environmental regulatory agency should be contacted to see if additional testing will be required. This also applies to remote sites that will probably require a septic tank or well. See paragraph 1.7, Section 5, "Pavement" for additional requirements for subsurface exploration with respect to pavement design.

1.3 SURVEY: A topographic survey shall be performed on the project site which provides the location of all aboveground and underground natural and constructed features and associated elevations. The order of the survey shall be as required to facilitate design and construction of the facility including any easements or property boundary establishments that may be required, including security clear zones (outside and inside) associated with boundary or restricted area security fencing. The survey shall be based on the National Geodetic Vertical Datum (NGVD) or other established datum which shall be clearly identified. Typically, contour intervals shall be on a one foot interval except in extreme flat or hilly terrain. A temporary benchmark shall be established at the project site that can be utilized during construction and the permanent benchmark used shall be identified on the drawings. Existing station as-built drawings may be used to identify utilities and storm drains, however, all information shall be field verified. To the maximum extent possible, all pavement types and thicknesses (including pavement layer thicknesses) shall be identified. The thicknesses may be obtained by reviewing existing as-built information, digging at the edge of the pavement, consulting with station personnel and applying good engineering judgment. Soil borings for the sole purpose of determining pavement thicknesses will not be allowed unless approved by SOUTHNAVFACENGCOM.

1.3.1 WETLANDS: Should unexpected wetlands be encountered during the survey, SOUTHNAVFACENGCOM should be contacted immediately..

1.4 PARKING LAYOUT: The parking layout shall be designed in accordance with NAVFAC Definitive Drawing 1404837, "Parking Area Criteria For Vehicles". For typical applications (90 degree parking), parking stalls shall be 9' X 18.5' and aisle widths 26'. Parking stripes shall be 4" wide and white. The total parking requirement (number of spaces) shall be coordinated with the user and be based on the construction funds available and geometric limitations of the site. To conform to security related restrictions, which are identified on the NAVFAC Definitive Drawing, the parking area location and layout shall conform to the following restrictions:

a. Parking of privately owned vehicles (POV's) within 20 feet of any building is prohibited for any project.
b. Parked vehicles within either the 20-foot minimum outside security zone or the 30-foot minimum inside security zone associated with restricted area security fencing (if applicable to the project) are prohibited. They are a hindrance to observation and a potential aid in circumventing the fence.
c. Where necessary on a site constricted by restricted area security clear zones, the designer may utilize parking area circulation drives as part of the security clear zone; in such cases, careful attention needs to be paid to the topography and features between the edge of the pavement and the Security Barrier (fence or building wall) to assure that vehicular traffic safety hazards and security clear zone violations are considered and avoided.
d. The security representative for the Activity shall identify other restricted areas where POV parking may be prohibited. These may include areas around flight line or aviation type facilities, controlled industrial facilities, certain waterfront facilities and magazines.

1.4.1 HANDICAP PARKING: Handicap parking and associated ramps/walks shall meet the requirements of the ADA (Americans with Disabilities Act) accessibility guidelines.

1.4.2 MOTORCYCLE PARKING: Motorcycle parking will typically be required on facilities such as barracks. Consult with the user on the number of spaces required. Motorcycle parking areas should be of 4" thick concrete and stalls should be 10' X 5'.

1.4.3 BICYCLE PARKING: Consult with the user on this requirement. Normally, bicycle parking is only required on facilities such as barracks. Provide a designated area of adequate size to accommodate the bicycle rack.

1.4.4 PARKING AREA CIRCULATION: Provide a system with adequate striping and signage which will allow for safe, convenient and logical circulation throughout the parking area. The system should allow for all types of traffic which may be associated with the facility including deliveries, emergencies and garbage pick-up. The system should, however, discourage through traffic.

1.4.5 TURNING RADII: Clearly indicate turning radii requirements on parking area entrances and islands. Where heavy trucks will have to enter the parking lot to make garbage pick-ups, for example, the A/E shall determine the required turning radii based on truck size and maneuverability.

1.5 SITE APPURTENANCES

1.5.1 SIDEWALKS: Typically, sidewalk requirements should be determined on the basis of need and capacity. The user should be consulted on any special walk requirements for such facilities as barracks where extra wide walks may be required for marching purposes and/or muster formation. Generally, sidewalks shall be constructed of 4" thick plain concrete with appropriate jointing shown on the plans. Tooled joints should be placed at intervals equal to the width of the sidewalk. Expansion joints should be placed at all intersections and where the walk abuts any structure. Where a sidewalk runs adjacent to a parking area and the layout utilizes curbing, the designer should consider an integral curb and walk, which is a sidewalk with a thickened edge.

1.5.2 CURB OR CURB AND GUTTER: Curb or curb and gutter should be utilized to aid in the collection of stormwater runoff, confine traffic and control erosion. The designer should investigate existing adjacent facilities to ensure site compatibility and continuity with respect to its use. Generally, curb or curb and gutter will be utilized in built-up areas where existing facilities have established a prior need for such use.

1.5.3 WHEELSTOPS: Provide 6' long precast wheelstops anchored to pavement with rebar at parking spaces adjacent to sidewalks or integral curb and walk. Coordinate with the activity for wheelstop requirements at other locations. The front face of the wheelstop shall be located 2'-6" from the edge of the pavement or sidewalk.

1.5.4 GUARD POSTS: Guard posts shall be 3' high 4" diameter steel pipe filled with concrete and painted yellow. Provide guard posts around any structures that are subject to damage from vehicular traffic and mowing equipment. Ensure that an adequate foundation is designed for the guard post.

1.5.5 SIGNAGE AND MARKINGS: Provide stop signs, handicap parking signs, no parking signs, etc. and associated pavement markings as required to facilitate proper utilization of the project site. Signage and markings shall be in accordance with the Federal Highway Administration's manual on Uniform Traffic Control Devices. Coordinate with the activity for activity specific requirements.

1.5.5.1 SECURITY SIGNAGE: For projects which include security fencing, including Station boundary fencing, consult with the Activity representatives to verify their site specific and project specific signage requirements. In general, the routes for these types of fencing and entry points/ gates should be posted with signage identifying the fencing as either a Government Property boundary or a Restricted Area boundary. Navy Security Instructions include specific requirements in regards to this type signage and there may also be site specific Activity requirements to be met. The provision of such signage can be accomplished in one of three ways: either as "government-furnished/government installed" signage (most frequent case); or as "government-furnished/contractor installed" signage; or as "contractor-furnished/contractor installed" signage.

1.5.6 TRASH DUMPSTER ENCLOSURE: Consult with the user on this requirement. If a dumpster is required, the enclosure should be designed by an architect, but the pavement in and around the enclosure should be designed by a civil engineer. Typically, the "floor" or pavement inside the enclosure and the pavement in front of the enclosure (for a distance of at least 10') should be designed and constructed of concrete. The enclosure should be located in a location which allows convenient access for the dumpster truck.

1.5.7 MECHANICAL ENCLOSURE: A mechanical enclosure will be required on most facilities for mechanical and electrical equipment. The design and location of the enclosure will be an interdisciplinary responsibility. The civil designer should review the location of the enclosure to ensure that all servicing, clearance and code requirements are met and that no existing or new utility or storm drainage conflicts are present.

1.5.8 FENCES: Fencing requirements shall be assessed based on security and safety requirements. For safety applications, a fence of the appropriate design should be provided around retention or detention basins particularly in residential housing areas, playgrounds, child care facilities, and other similar applications where a fence will enhance the welfare and safety of children. If a fence is required for any other application, the A/E shall consult with the Activity Security Officer to determine if the fence must comply to applicable security criteria. For security applications, refer to Section 6, which identifies applicable NAVFAC design criteria containing detailed guidance for security fencing, gates, and other security features. For most security applications, the following guidance is applicable:

a. Use chain-link fencing. NAVFAC guide specification NFGS-02831 and federal specification RR-F-191 are the primary criteria documents for security fencing components. Specify the steel materials options; do not specify the aluminum fabric, posts, or accessories options for security applications.
b. Provide a fence with a total height of 8 feet; 7-foot-high fence fabric plus 1-foot vertically for 3-strands of barbed wire on 45-degree outrigger. Specify 9 gauge steel fabric with openings not greater than 2 inches and with twisted and barbed selvages at both top and bottom.
c. Use of top rails is prohibited. Show and specify use of top tension wire instead.
d. Keep the number of gates and perimeter entrances to the minimum required for safe and efficient operation.
e. Generally, grounding is not required for chain link fences mounted on metal posts. However, fences shall be grounded on each side of every gate and at other locations when the fencing is near and parallel to high tension power lines; at intervals of 1000 to 1500 feet when the fencing runs through isolated areas and at lesser distances depending on proximity of the fencing to public roads, highways, and buildings; when the fencing is around or within any explosives storage (magazine), production, operating, or handling areas. Refer to Section 6, which identifies

applicable NAVFAC Design Criteria containing more detailed guidance (MIL-HDBK-1013/10, paragraph 2.3.9).

f. Unless otherwise directed, locate the security fence at least 30 feet from structures. Provide an outside security clear zone not less than 20 feet wide immediately outside the fence. Keep this area devoid of buildings, parking areas, poles, guy line anchors, shrubs, trees, sign boards, and any other object that could conceal personnel or hinder observation. Provide a similar interior security clear zone at least 30 feet wide immediately inside the fence. Unless specifically authorized, including concurrence of the Installation/Base Security Officer (Navy)/Provost Marshal (Marine Corps), ensure this inside clear zone meets the requirements of the exterior clear zone, except for the installation of protective lighting poles/masts and other features which do not hinder observation.

g. Where existing security fencing is being removed and installation of new security fencing must be delayed due to other site preparation work, security shall be maintained by phasing or sequencing of the work.

SECTION 3

GRADING AND STORM DRAINAGE

1. DESIGN CRITERIA: Grading, drainage design and associated construction (stormwater management) shall meet the requirements of the applicable regulatory agency that governs stormwater management and/or the State's Department of Transportation where the project is located.

2. FACILITY DEGREE OF PROTECTION: The degree of protection for a facility against flooding is expressed in terms of years (storm frequency). Of utmost importance, is flooding of buildings. A building's minimum finished floor elevation should be established based on local flood plain elevation data and the degree of protection (in years) required for a particular building. For contributing watersheds less than 100 acres, which will be typical for the majority of facilities, the following storm frequencies (in years) shall be utilized to establish elevation requirements:

a. Industrial, administrative and housing facilities - 50 year storm
b. Hazardous, chemical, communication, hospitals and defense operational facilities - 100 year storm
c. Recreational facilities - 25 year storm

For facilities with contributing watersheds greater than 100 acres, refer to military handbook 1005/3, "Drainage Systems", for degrees of protection. The degree of protection (in years) for the drainage systems, roads, and parking areas shall be in accordance with local permitting or regulatory requirements.

3. STORMWATER MANAGEMENT

3.1 GENERAL INFORMATION: This document only refers to surface storm drainage, underground closed conduit gravity drainage systems and storage facilities. Pressure systems will only be used where minimum velocity requirements cannot be maintained and grades simply will not allow the use of a gravity system. Pressure systems are covered in other criteria and should be addressed on an individual basis.

3.2 DESIGN REQUIREMENTS: To the maximum extent possible, the following objectives and principles should be applied in the design of a stormwater management system:

a. The volume, rate, timing and pollutant load of stormwater after development should closely approximate the conditions which existed before development such that existing system capacity requirements do not increase.

b. The stormwater management system should mimic (and use) the features and functions of the natural drainage system and follow the contour of the existing topography.
c. Utilize surface drainage or "sheet flow" in lieu of closed conduit systems if land uses permit.
d. Maximize on-site storage of stormwater.
e. The design should ensure that adequate erosion and control practices are applied during both the construction and operational phase of the facility.
f. The stormwater management plan should comply with local regulatory requirements and EPA requirements with respect to the NPDES Construction Notice of Intent permit.

3.3 SURFACE STORM DRAINAGE

3.3.1 GRADING REQUIREMENTS: Grade the site to provide positive drainage away from the building. For the first 10 feet, provide a minimum slope of 5 percent and, where possible, 10 percent. Establish finished floor elevations at least 6 inches above finished grade at perimeter of building. Provide a ramp or walk to meet the finished floor at the building entrance. Ensure that the drainage system does not adversely affect surrounding sites. Discharge areas, drainage ditches and swales shall be protected to prevent erosion by appropriate means such as sod, rip rap, paved surface, etc. Minimum grades shall be as follows:

a. 0.3 percent for paved surfaces
b. 0.5 percent for unpaved surfaces
c. 0.3 percent for paved ditches
d. 0.5 percent for unpaved ditches

3.4 UNDERGROUND STORM DRAINAGE

3.4.1 SYSTEM DESIGN: The following design criteria shall be utilized in the design of an underground storm drainage gravity system:

a. OVERLAND FLOW: Overland flow values and associated design parameters such as rainfall data, storm frequency, stormwater quality standards and hydrograph computation methods can vary significantly and shall be computed in accordance with local regulatory requirements. If there are no regulatory requirements where the project is located, utilize the design methodologies given in Military Handbook 1005/2, "Hydrology".
b. MINIMUM PIPE SIZE: Storm drainage pipe (not including roof drainage) shall have a minimum inside diameter of 12 inches except as indicated in paragraph 3.13.2 for underground drainage crossings below security fencing.

c COVER REQUIREMENTS: The system should initially be evaluated based on a cover requirement of 2 ft. for typical traffic loadings. When 2 ft. of cover is unobtainable, pipe material selection and bedding requirements should be evaluated to ensure the load carrying capacity of the pipe is not exceeded (see paragraph 3.7.1 for additional information).

d. SLOPE, VELOCITY AND FLOW REQUIREMENTS: Design pipe slopes to provide a minimum flow velocity of 2.5 feet per second using the Manning equation (with an "n" value of 0.013 for smooth wall pipes) with the pipe flowing full and under no surcharge at peak flow conditions. A minimum flow velocity of 2.0 feet per second will be acceptable only if appreciable cost benefits can be realized. Maximum flow velocity shall be 15 feet per second.

e. OUTLET REQUIREMENTS: The design of culverts and storm drains shall take into consideration tailwater and the effect it has on the capacity of the pipe. Discharge areas shall be protected to prevent erosion.

f. HYDRAULIC CONSIDERATIONS: Where storm drains enter and leave drainage structures such as manholes or catch basins, the inlet pipe crown elevation should be equal to or greater than the outlet pipe crown elevation to minimize hydraulic turbulence at the junction. Also, the slope of the flow channel in the manhole or catch basin shall be approximately equal to the slope of the inlet pipes. Regardless of hydraulic considerations, do not decrease the pipe size in the direction of flow.

3.5 ROOF DRAINAGE: Most roof drainage will be discharged vertically at locations along the perimeter of the building into the underground drainage systems. Wherever possible, locate roof drain connections at manholes or other access structures. Otherwise, connect roof drains with appropriate fittings to the receiving pipe.

3.6 SYSTEM LAYOUT: The system should be laid out to minimize piping runs. Normally, provide straight alignments for piping between storm drainage structures with deflection at structures no greater than 95 degrees for main line flow and 120 degrees for contributory flow lines. Use of curvilinear piping is not allowed. The following additional guidance should be applied to system layout:

a. Junctions (primarily manholes) should be located out of paved areas if possible.

b. Storm drainage piping should never go under buildings and should be a parallel distance of at least 10 ft from building foundations.

c. Conflicts at sanitary sewer and water crossings should be avoided. Conflict boxes will not be allowed unless absolutely necessary.

d. Storm drainage piping shall be laid in its own trench.

e. Catch basins, drop inlets and manholes should be located as required to collect surface runoff and convey it off the site. Provide a structure at pipe junctions and where there is a change in the horizontal or vertical alignment of a pipe run. For cleaning purposes, provide a manhole or catch basin at least every 400 ft. for pipes

48 inches in diameter and smaller and at least 800 ft. for pipes larger than 48 inches in diameter.

3.7 MATERIAL SELECTION

3.7.1 STORM DRAINAGE PIPE: For most typical installations, storm drainage pipe (not including roof drainage) shall be reinforced concrete pipe conforming to ASTM C 76, Class III unless loading conditions and soil conditions warrant a different Class or strength of pipe. Where cover requirements cannot be met, consider reinforced concrete arch shaped pipe or reinforced concrete elliptical pipe conforming to ASTM C 506 and ASTM C 507, respectively. Also, consider different bedding materials to enhance the load carrying capacity of the pipe. Refer to the Concrete Pipe Design Manual (latest edition) of the American Concrete Pipe Association for guidance and design procedures by which the applicable Class or strength of pipe can be determined. Construction vehicular traffic loadings should be considered in the selection of pipe Class/strength. The minimum cover of pipes shall be 12 inches regardless of class or strength of pipe selected. Measure the cover from the top of the pipe to the bottom of rigid pavement and to the top of flexible pavement or finished grade. Use of other pipe materials will be considered provided it is appropriate for intended use and it can be justified from both an engineering and cost viewpoint.

3.7.1.1 CORRUGATED ALUMINUM OR STEEL PIPING: Use of corrugated aluminum or steel piping shall be considered in areas subject to high settlement of soils. The inside of the corrugated pipe should be lined for improved hydraulic performance. Both the aluminum and steel pipe should have an appropriate coating (i.e. bituminous, zinc, polymer, etc.) based on the corrosiveness of the soil and drainage the pipe will be exposed to (i.e. highly acidic or highly alkaline soils, tidal drainage, etc.).

3.7.2 ROOF DRAINAGE: Provide PVC pipe ASTM D3034, SDR 35 to convey the roof drainage from downspouts to a manhole or catch basin in the drainage system. Provide ductile iron pipe (ASTM A746) for pipes that cross traffic pavements if there is less than 2 ft. of cover.

3.8 PIPES WITH FREE OUTLETS: Culverts and underground storm drainage pipes shall have either concrete headwalls, endwalls, wingwalls, flared or mitered end sections at free outlets.

3.9 SAFETY: In residential housing areas where the ends of storm drains are not otherwise protected, i.e., by a fence or physical land feature, provide hinged grates at both ends of culverts 24 inches in diameter and larger.

3.10 CATCH BASINS, MANHOLES AND DROP INLETS: Ensure that catch basins, manholes and drop inlets are of adequate size to accommodate inlet and outlet pipes and receive overland flow design values. Where a connection is made to an existing structure, the flow channel shall be reworked as necessary and the connection shall be grouted to be watertight.

3.11 CATCH BASIN GRATES: Design catch basin grating to withstand traffic loading requirements and be of "bicycle proof" design. Reference the appropriate federal specification or manufacturer to identify the desired grating to be used

3.12 STORMWATER STORAGE FACILITIES: Stormwater storage facilities will typically consist of detention or retention facilities or swales. A detention facility temporarily stores a given volume of stormwater runoff and provides for treatment generally through physical or biological processes with subsequent gradual release of stormwater into surface waters of the state. A retention facility permanently stores a given volume of stormwater by complete on-site storage with no discharge into surface waters of the state; discharge in a retention facility is accomplished only through evaporation or infiltration. The requirement for stormwater storage facilities will be based on local regulatory requirements, where applicable. Where no stormwater management regulations exist, the drainage designer shall consider the following:

a. IMPACT OF STORMWATER RUNOFF: Consider the impacts of changes in stormwater volume, peak flow rates, and quality in the receiving stream associated with project.
b. MITIGATION OF ADVERSE IMPACT: If it is determined that the project will increase the likelihood or extent of minor flooding, accelerate erosion, or degrade the water quality of the receiving stream, the designer shall employ a management plan which utilizes stormwater storage facilities to mitigate adverse impacts.

3.13 SECURITY REQUIREMENTS FOR DRAINAGE SYSTEMS

3.13.1 SURFACE DRAINAGE BELOW SECURITY FENCING: Provide security barriers at all locations where security fences must cross drainage ditches or swales to assure that intruders are prevented from passing under the fence without a delay. Depending on the configuration of the drainage channel (width, depth, side slopes) and flow conditions within the channel, there are several alternative design solutions that may be selected to suit a particular situation. They range from a relatively simple additional segment of fencing to extend from the bottom portion of the main fencing section to the grade at the channel bottom with fastening and anchorage enhancements to the more complex, such as a steel bar grill work or change to an underground system of structures with multiple 10-inch diameter piping. Refer to Section 6, which identifies applicable NAVFAC Design Criteria containing more detailed guidance.

3.13.2 UNDERGROUND DRAINAGE CROSSINGS BELOW SECURITY FENCING: Pipes crossing under security fences which have a cross-sectional area of 96 square inches or greater, with the smallest dimension being more than 6 inches, or which are larger than 10 inches in diameter, require protective measures. These measures require the provision of either multiple pipes of 10 inches diameter (maximum) when passing under security barriers and/or other security enhancements at unprotected drainage structures within the system to deny or delay an intruder attempting to circumvent the fence. Depending on the configuration of the underground system and

type and location of unsecured drainage structures that may be accessible to an intruder, there are several alternative design solutions that may be selected to suit a particular situation. They range from relatively simple, such as using lockable manhole covers and grates inside a secured area, to the more complex, such as a steel bar grill work on open pipe ends or system of structures with multiple 10-inch diameter piping. Refer to Section 6, which identifies applicable NAVFAC Design Criteria containing more detailed guidance.

SECTION 4

WATER AND SANITARY SEWER

1. DESIGN CRITERIA: Potable water and sanitary sewer design and the associated construction shall meet the requirements of the applicable regulatory agency that governs and issues permits for the installation and operation of these systems.

2. POTABLE WATER

2.1 GENERAL INFORMATION: This document refers only to potable water systems. Nonpotable water systems (raw water and sea or salt water systems) shall be addressed on an individual basis.

2.2 DESIGN REQUIREMENTS: In order to properly design potable water services, the engineer shall:

a. Determine the required flow and residual pressure. This information should be calculated based upon the peak demand. Consideration shall be given to fire protection systems, industrial processes, and the domestic demands.
b. Determine the available flow at the residual pressure at the point of connection. For preliminary planning and/or programming purposes, this information can be obtained from the station public works or fire department personnel. For final design, however, the engineer shall conduct flow tests in accordance with NFPA 291. Results of these flow tests should be included in the Basis of Design and/or calculations.

2.3 SIZING OF MAINS AND SERVICE LINES: Select the smallest pipe that will satisfy all of the following conditions:

a. The residual water pressure at peak flow shall not be less than 20 psi. Some facilities will have a requirement for higher pressures. The civil engineer shall coordinate this requirement with the mechanical/plumbing and fire protection engineers for the project.
b. If a new automatic fire extinguishing system is being provided, residual pressure shall meet the requirements for activation of the system while simultaneously providing 50 percent of the average domestic and industrial flows.
c. Velocities greater than 10 feet per second should be avoided.
d. Water distribution mains shall be a minimum of 8 inches in diameter.

2.4 MATERIAL SELECTION

2.4.1 WATER MAINS: For most installations, water mains 12 inches in diameter and less shall be either PVC pipe (AWWA C900) or ductile iron pipe (AWWA C151). Water mains larger than 12 inches in diameter shall be ductile iron pipe. Other materials may be appropriate on certain projects and should be evaluated on a case by case basis. SOUTHNAVFACENGCOM, Civil Division approval shall be obtained before specifying materials other than PVC (AWWA C900) or ductile iron (AWWA C151).

2.4.1.1 All ductile iron pipe shall be in accordance with AWWA C151 and have a cement-mortar lining in accordance with AWWA C104. In all coastal areas and in areas where corrosion may be a problem, the ductile iron pipe shall be wrapped in polyethylene in accordance with AWWA C105.

2.4.1.2 All PVC piping used for water mains shall be in accordance with AWWA C900. PVC piping shall not be used in any aboveground applications.

2.4.2 WATER SERVICE LINES: For most typical installations, water service lines shall be copper tubing (ASTM B88), PVC (ASTM D1785) or ABS (Acrylonitrile-butadiene-styrene) plastic (ASTM D1527). All service lines and fittings shall have a minimum pressure rating of 150 psi. Service lines of 4 inch and 6 inch diameter shall be PVC pipe (AWWA C900) or ductile iron pipe (AWWA C151). Solvent welded PVC joints shall not be used.

2.5 BACKFLOW PREVENTION: Contact the local public works office for the activity to determine if a backflow prevention program exists at the activity. In the event that such a program exists, provide backflow prevention in accordance with this plan; either double check valve assembly type or reduced pressure type. All backflow prevention devices specified must be on the current list of approved backflow prevention devices published by the Foundation for Cross-Connection Control and Hydraulic Research (FCCCHR).

2.6 VALVES AND HYDRANTS

2.6.1 VALVES: Valves shall be installed at all new points of connection and where necessary to insure adequate sectionalization of the water distribution system. Valves shall be placed in protective valve boxes and located outside of pavement and heavy traffic areas whenever possible.

2.6.2 HYDRANTS: Locate fire hydrants in accordance with the requirements of MIL-HDBK-1008A. Provide a 6 inch minimum diameter valved service connection to each fire hydrant.

2.7 SYSTEM LAYOUT: The layout of the water systems should minimize the lengths of new lines while providing the best hydraulic solution to the project. Distribution systems should be

looped as much as possible. Provide adequate thrust restraint. Minimum cover should be 3 feet. In locating mains and service lines consider the following:

a. Water lines should be clear of all structures, adjacent to and parallel to streets, and where possible out of roadways.
b. Water lines should be laid in trenches separate from sewer lines, and above and at least 10 feet away from nearby sewers; preferably on the opposite side of the street.
c. Where a sanitary sewer crosses over a water line, the portion of the sewer line which is within 10 feet of the water line (on both sides) shall be of pressure pipe or encased in at least 8 inches of concrete.

3. SANITARY SEWER

3.1 GENERAL INFORMATION: This document refers only to the collection system for domestic wastewater. Industrial waste collection systems, though similar in nature, are covered by other criteria and should be addressed on an individual basis.

3.2 DESIGN REQUIREMENTS: Consideration must be given to the capacity of the existing sanitary sewer collection system to identify a suitable point of connection. When anticipated flows are minimal (less than 500 gallons per day (gpd)), an analysis of the existing sewer capacity is not necessary. For flows greater than 500 gpd, existing sewer capacity must be determined. This information can be obtained from field measurements (flow testing) or from public works personnel.

3.3 SIZING OF SANITARY SEWER LINES: No sewer mains shall be less than 8 inches in diameter. Service connections for single family dwellings or equivalent (approximately 500 gpd) shall be at least 4 inches in diameter. All other building service connections shall be at least 6 inches in diameter. Additional design criteria for gravity sanitary sewers lines are as follows:

a. SLOPES: Design pipe slopes to ensure a velocity of at least 2.5 feet per second (fps) when pipe is flowing full at peak flow. Velocities as low as 2.0 fps when flowing full are permitted where appreciable cost benefits can be realized. The velocity should not exceed 10 fps under any circumstances. The following are recommended minimum slopes:

Sewer Size	2 fps Minimum Slope (feet/100 feet)	2.5 fps Minimum Slope (feet/100 feet)
4 inch**	1.05	1.35
6 inch**	0.65	0.85

8 inch	0.40	0.54
12 inch	0.22	0.33
15 inch	0.15	0.23
18 inch	0.12	0.18
24 inch	0.08	0.125

The pipe diameter and slope shall be selected to obtain greatest practical velocities to minimize settling problems. If the proposed slope is less than the minimum slope, calculations showing actual depths and velocities anticipated shall be provided.

Gravity mains shall be laid with uniform slope between manholes.

b. DESIGN FLOWS: Use the Manning formula to design sewers to flow full, under peak flow. Use a friction factor "n" of 0.013.

c. DEPTH: Design all sewers to maintain the minimum cover required to protect the structural integrity of the pipe. Any pipes with less than 2 feet of cover shall be ductile iron pipe (ASTM A746).

3.4 MATERIAL SELECTION

3.4.1 GRAVITY SEWER LINES: For most installations, sewer mains and service connections shall be either ductile iron pipe (ASTM A746), PVC pipe (ASTM D3034, SDR 35), or ABS plastic pipe (ASTM D2751 or ASTM D2680). Other materials may be appropriate on certain projects and should be evaluated on a case by case basis. SOUTHNAVFACENGCOM, Civil Division approval shall be obtained before materials other than those listed are specified.

3.4.2 SEWER FORCE MAINS: For most installations, sewer force mains 4 inches and larger shall be either ductile iron pipe (AWWA C151) or PVC pipe (AWWA C900). Force mains smaller than 4 inches shall be PVC (ASTM D-1785); no solvent welded joints shall be used.

3.5 SYSTEM LAYOUT: All sewer lines shall be laid with straight alignment between manholes and/or cleanouts. Curvilinear alignment of sewer lines is not acceptable. The maximum spacing between manholes is 400 feet. Any change in direction or slope requires a manhole. For service connections (4 & 6 inches in diameter), where a change in slope and/or direction occurs, the manhole can be replaced by a cleanout, provided that the length of service line down stream of the cleanout is not longer than 150 feet. In locating sewer lines and manholes consider the following:

a. Sewer lines should be clear of all structures, adjacent to and parallel to streets, and where possible, the manholes should be located out of roadways and paved areas.

b. Sewer lines should be laid in trenches separate from water lines, and below and at least 10 feet away from nearby water lines; preferably on opposite sides of the street.

3.6 MANHOLES: The minimum diameter of manholes shall be 48 inches; larger diameters may be required for large diameter sewers. Manhole steps shall be provided in accordance with AWWA C478.

3.6.1 DROP MANHOLES: Drop manholes shall be provided for any manhole where the difference between the inlet pipe invert elevation and the manhole invert elevation is greater than 24 inches. The entire outside drop connection shall be encased in concrete.

3.6.2 FLOW CHANNEL: The flow channel through the manhole shall be made to conform as closely as possible to the shape and slope of the connecting sewers. Whenever connections are made to existing manholes, the bench of the manhole should be re-worked to provide proper flow channels. Flow from inlet pipes should never enter in the opposite direction to the flow in the manhole.

3.7 LIFT STATIONS: Use pumping only where a gravity system cannot serve hydraulically or where cost analysis shows a significant savings. In addition to coordinating with the applicable regulatory and permitting agency and base public works personnel, adhere to the following criteria:

a. Provide two pumps, each sized to handle the peak flow, for most installations.
b. Pumps shall be capable of passing 3 inch solids. For small installations (less than 250 gpm), pumps capable of passing 2-1/2 inch solids are acceptable when the pumps are preceded by a bar screen; consider using grinder pumps to eliminate the need for a bar screen.
c. Pump stations must have adequate ventilation and lighting, and provide for personnel access.
d. All lift stations shall have high level alarms that are both audible and visible.

3.8 FORCE MAINS: Force mains should be kept as short as possible. Maintain a minimum velocity of 3 fps. Velocities should not exceed 10 fps. All force mains should have a minimum of 3 feet of cover. Provide adequate thrust restraint.

SECTION 5

PAVEMENT

1. GENERAL:

1.1 For geometric design of vehicular roads and streets refer to AIR FORCE AMF 88-7 CHAP 5 "GENERAL PROVISIONS AND GEOMETRIC DESIGN FOR ROADS, STREETS, WALKS AND OPEN STORAGE AREAS". For layout of parking lots refer to NAVFAC Definitive Drawing Number 1404837.

1.2 For geometric design of airfield pavement facilities refer to MIL-HDBK-1021/1, "AIRFIELD GEOMETRIC DESIGN".

1.3 Use flexible pavement for economy in construction cost and where portland cement concrete paving is not required. In those cases where either pavement type is acceptable and economically competitive, provide pavement designs for both types.

1.4 The design of pavements shall take into consideration the anticipated traffic over the life of the project (typically 20 years) and the soil conditions existing at the site. Many times traffic information is not available and the engineer will have to make some assumptions based on his own experience and information received from activity personnel.

1.5 Use portland cement concrete pavement in refueling and service areas where petroleum products regularly drip or leak on the pavement and would be detrimental to asphaltic pavement. Portland cement concrete pavement may also be required in areas where insitu soil conditions warrant its use due to poor bearing capacity. Use portland cement concrete pavement in motorcycle parking areas and in areas where tractor trailers are parked to better withstand point loads imposed by kickstands and stabilizing jacks.

1.6 The design of the pavement section shall take into consideration the potential for freeze and thaw conditions in the base course layer. When there is a potential for freeze and thaw occurring in the base, the base course shall be designed as a free draining base and shall extend into the subgrade to a depth equivalent to the depth of the freeze line. The swelling potential of soils with high plasticity indexes should also be considered. Stabilization of such soils with lime, cement, asphalt, fly ash or a combination thereof may be beneficial.

1.7 Generally, soils information required for pavement design is obtained through the use of shallow borings (typically 10'). The soils report, as a minimum, should include boring locations,

boring logs, unified soil classification for all soils encountered, grain size analysis (ASTM D422), plastic limit and
plasticity index (ASTM D4318) and in place moisture content. The soils report should also indicate, depending on anticipated pavement type, the California Bearing Ratio (CBR) or the subgrade support value (K) of the subgrade soils.

1.8 The strength of base and subbase material, whether under asphalt or concrete pavement, shall be measured by its California Bearing Ratio (CBR) as determined by ASTM D1883.

1.9 Pavement markings and signage should be in accordance with Federal Highway Administration standards as given in "Rigid Sign Supports" and "Manual of Uniform Traffic Control Devices."

1.10 Pavement design calculations shall be included with the Basis of Design providing all pertinent information used in determining the required pavement section.

2. ASPHALT PAVEMENT:

2.1 For guidance in designing asphaltic pavement sections for roads, streets and parking lots refer to NAVFAC DM 5.4, "PAVEMENTS".

2.2 Flexible pavements shall be designed based on the anticipated traffic and the load carrying capacity of the insitu soils as determined by a 4-day laboratory soaked California Bearing Ratio (CBR) test (ASTM D1883).

2.3 In designing the pavement section, use anticipated in place CBR values for soils which may be degraded by remolding such as clays. Anticipated in place CBR values should also be used when dealing with silts, very fine sands, or other soils which may become quick or spongy, by pumping, in high water content areas. Consideration to stabilizing existing material with lime, cement or bitumen should be considered when economically attractive. When insitu soils are improved by compaction or stabilization, use the CBR value which is anticipated upon completion of improvement for designing overlying asphalt pavements.

2.4 The following minimum asphalt thicknesses shall be adhered to:

Primary road	3 inches
Secondary road	2 inches
Parking areas	2 inches
Driveways	1.5 inches
Surface used by tracked vehicles	4 inches.

Thickness of surface course for secondary roads and parking areas

may be reduced to 1 1/2" when placed on an asphalt or limerock base.

2.5 Asphalt mixes for vehicular pavement shall have a minimum stability of 1000 pounds as determined by the "Marshall Method of Mix Design". In areas of heavy truck movements, consider specify 1800 pound stability asphalt for more rut resistant pavement. Use the 75 blow compaction procedures for designing primary roads and streets. For secondary roads, streets, and parking areas, use the 50 blow procedure.

2.6 Maximum aggregate size for an asphalt mix shall be 1/2 the lift thickness. When this aggregate is subjected to the Los Angeles Abrasion test, the loss in material shall not exceed 40%.

2.7 Asphaltic surface courses shall be placed in maximum 2" compacted lifts. Asphaltic binder and base course may be placed in maximum 4" lifts provided all compaction requirements are met.

2.8 Typically, an 80 CBR base course material should be used beneath asphaltic pavements. However, for low volume secondary roads and parking lots, a minimum CBR value of 60 may be allowed.

2.9 Subbase courses underlie base courses and are generally constructed of material having a minimum CBR value of 30.

2.10 Prime coats shall be used between new base course material and asphaltic surface course.

2.11 Tack coats shall be placed between successive layers of asphaltic concrete.

2.12 The bitumen specified should be suitable for the climate in which you are working.

2.13 SPECIAL AIRFIELD REQUIREMENTS:

2.13.1 For guidance in designing asphaltic pavement sections for airfield pavement refer to NAVFAC DM 21.3, "FLEXIBLE PAVEMENT DESIGN FOR AIRFIELDS".

2.13.2 Upon completion of base course construction, proof roll on center 25 feet of taxiways and on center 100 feet of runways by eight coverages of the proof roller. To all other paved areas, exclusive of runway overrun and blast protection areas, apply four coverages.

2.13.3 Base courses shall be constructed of 80 CBR material.

2.13.4 Asphaltic concrete for airfield pavements shall be designed to provide min. 1800 pound stability and shall be based on a 75 blow Marshall mix design.

2.13.5 The following minimum thicknesses for airfield pavements shall be adhered to:

GROSS LOAD	TIRE PRESSURE	MINIMUM THICKNESS
< 12 kips	all tire pressures	2" surface 6" base
12 to 30 kips	less than 200 psi	2" surface 6" base
	greater than 200 psi	4" surface 8" base
> 30 kips	all tire pressures	4" surface 8" base

2.13.6 The aggregate used in asphalt mixes, when subjected to the Los Angeles Abrasion test, shall show a loss not to exceed 40% for surface courses and not more than 50% for base course.

2.13.7 The coarse and fine aggregates used for airfield pavements should be crushed materials in order to assure high stability and performance. Mixes using river run gravel should not be used in surface courses.

3. PORTLAND CEMENT CONCRETE PAVEMENT:

3.1 For guidance in designing portland cement concrete pavement sections for roads, streets and parking lots refer to NAVFAC DM 5.4, "PAVEMENTS".

3.2 Design of the portland cement concrete pavement shall be based on the subgrade support value "K" of the subgrade. Estimated values of subgrade support values are acceptable if adequate subsoil investigations have been made. Do not use estimated values of subgrade support values exceeding 300, unless substantiated by field-bearing test results. Values in excess of 500 should not be used regardless of test results.

3.3 Unless special conditions warrant, portland cement concrete pavement sections should be designed based on using 28 day, 650 psi flexural strength concrete.

3.4 Concrete mix shall be designed as an air entrained concrete and shall have a maximum water cement ratio of 0.5. The amount of cement shall be as required to achieve the desired strength with the anticipated aggregate.

3.5 Typically portland cement concrete pavement should be designed as non reinforced pavement. In areas where odd shaped slabs occur, i.e., length of slab exceeds width of slab by more than 25%, reinforcing shall be added to offset temperature related stresses. Clearly indicate those slabs which will require reinforcing on the drawings.

3.6 Joints shall be laid out in a uniform rectangular pattern to provide a typical 12.5' x 15' slab spacing. Typically this means that paving lanes will be 25' wide with transverse joints placed on 15' centers.

3.7 Joints shall be designed to accommodate edge stresses built up as vehicles approach the joint. This is normally accomplished through thickening the edges for expansion joints and by load transfer in keyed construction joints and contraction joints. Clearly show and label all joints and provide typical details for all joints used.

3.8 New concrete pavement typically does not require any interior expansion joints due to the fact that at time of placement the concrete is at its largest volume and from that point shrinks. Place thickened edge expansion joints between new and existing pavement and where opposing runs of concrete meet. Use non thickened expansion joints in areas of no traffic such as between pavement and buildings.

3.9 Base courses under concrete pavement, shall have a minimum CBR value of 30.

3.10 In certain areas, such as in the Memphis area, we have experienced problems with alkali reactions with local aggregates. Specify low alkali cement or different aggregates when working in areas where similar problems occur.

3.11 SPECIAL REQUIREMENTS FOR AIRFIELDS:

3.11.1 For guidance in designing portland cement concrete pavement sections for airfield pavement refer to MIL-HDBK-1021/4, "RIGID PAVEMENT DESIGN FOR AIRFIELDS".

3.11.2 The minimum design life for Navy and Marine Corps facilities is 20 years. Obtain data for the specific Navy and Marine Corps airfield facility under design to forecast aircraft traffic operations over the design life of the pavement. When site specific traffic projections are not available, the aircraft pass levels listed below are the minimum pass levels to be used in design.

F-14	300,000
P-3	100,000
C-130	50,000
C-141	25,000
C-5	25,000

3.11.3 Minimum thickness for utilization of keyed joints in airfield pavements is 9". Pavement sections of less than 9" must be constructed of butt joints on a stabilized base. The economics of going to a thicker pavement and deletion of stabilized base requirements should be considered.

3.11.4 Minimum aggregate base course thickness is 6". Actual thickness shall be as required to provide a minimum support value "K" of 200.

3.11.5 Design hangar floors for 60% of the maximum gross weight of the aircraft with a minimum floor thickness of 8".

SECTION 6

EXTERIOR SITE-RELATED PHYSICAL SECURITY

1. GENERAL: Physical Security requirements for new construction should be identified during the planning stage and included in the project design. Navy Physical Security and Loss Prevention Manual, OPNAVINST 5530.14B, requires that plans for new construction and modification/upgrade be reviewed by the activity security officer/provost marshal or designated representative during the design process and various review phases. The SOUTHNAVFACENGCOM Physical Security Design Engineer/ Point of Contact may also review project designs which have significant physical security requirements or features.

2. DESIGN CRITERIA: Physical security is concerned with limiting, controlling, or preventing personnel access to specific areas. Almost every project design involves Physical Security to some degree. Major projects for Physical Security enhancements and/or upgrades are usually easily identifiable as such; however, the requirement for Physical Security Features may be less apparent on many smaller projects.

Exterior Physical Security addresses the outermost elements of a "Physical Security System" of features between the Site Perimeter and the Facility containing the assets to be protected. External security requirements in many cases depend on internal security measures and on the type of protection required. Normally, external considerations, including building location and orientation and the use of protective barriers and lighting, are developed as part of the facility's security plan within the overall Installation/Base Security Plan and should be identified in the supporting Project Planning Documentation for the facility.

The following Design Criteria shall be utilized by the Designer in developing all Project Designs. While not every project will include every Physical Security consideration and/or feature, they are the Designer's "road map" in identifying and designing to at least minimum requirements.

(a) MIL-HDBK-1013/1A, "DESIGN GUIDELINES FOR PHYSICAL SECURITY OF FACILITIES".

This Criteria Manual provides guidance to ensure that appropriate physical security considerations are included in the design of facilities. It includes general overviews and guidance for both the Pre-Design and Design phase efforts. Specific technical sections include **exterior site physical security**, building physical security, ballistic attack hardening, standoff weapon hardening, and bomb blast hardening.

The manual also includes a design flow chart that outlines a recommended procedure for designing an integrated physical security "system", commencing with a "preliminary layout of site and building" and continuing through the numerous site related

considerations. There is also a set of worksheets to aid the design process by evaluation of site and building construction options.

(b) MIL-HDBK-1013/10, "DESIGN GUIDELINES FOR SECURITY FENCING, GATES, BARRIERS, AND GUARD FACILITIES".

This Criteria Manual provides the latest state-of-the-art criteria for security fencing, gates, barriers, and guard facilities and is primarily intended for use by NAVFACENGCOM design engineers and architectural and engineering firms. The contents cover specific criteria to be used during the selection, design, and construction of security fencing, gates, barriers, and guard facilities for perimeter boundaries of Navy and Marine Corps installations or separate activities and for designated restricted areas.

This Criteria Manual supersedes the security-related portions of older NAVFAC Design Manual (DM) 5.12, "Fencing, Gates and Guard Towers", dated October 1979.

(c) Various Facility Design Criteria/Military Handbooks (MIL-HDBK's) for other Civil Engineering Design Features or Facilities in the MIL-HDBK-1005/xx Series which have Paragraphs which also address Physical Security requirements. Some examples of such include MIL-HDBK-1005/3 "DRAINAGE SYSTEMS" and MIL-HDBK-1005/13 "HAZARDOUS WASTE STORAGE FACILITIES".

(d) Various Facility Design Criteria/Military Handbooks (MIL-HDBK's) for other specific types of Facilities in other MIL-HDBK-10xx/xx Series which have Paragraphs which also address site Physical Security requirements and considerations for that type of Facility. Some examples of such include MIL-HDBK-1012/1 "ELECTRONICS FACILITIES ENGINEERING", MIL-HDBK-1028/1 "AIRCRAFT MAINTENANCE FACILITIES", and future MIL-HDBK-1024/1 "AVIATION OPERATIONAL AND SUPPORT FACILITIES".

SECTION 7

SUBMITTAL REQUIREMENTS

1. GENERAL: The submittal requirements for different projects vary based on the scope and urgency of the project and the particular funding agency. Some projects may proceed directly to the 100% submittal stage while others may require a Project Engineering submittal, 35% submittal and 100% submittal. The A/E's "Statement of Work" will indicate the exact submittal requirements. For submittal requirements at the various design stages, refer to the A/E Guide, SOUTHNAVFACENGCOM P-141. Otherwise, a submittal shall contain the following applicable information with regards to civil design.

1.1 BASIS OF DESIGN: The Basis of Design shall include the following information:

a. Site Development: Describe the site of the project, its natural advantages and disadvantages relative to the proposed project, vegetation, trees and topography which can be utilized in the enhancement of the completed facility. Outline the proposed landscaping and other site work necessary to complete the site development. Include physical security requirements and considerations.

b. Storm Drainage: Describe the storm water management system for the project and its merits in relation to the requirements of the governing regulatory agency. Provide a description of key elements of the system such as detention or retention ponds, swales, exfiltration trenches, etc. Describe any erosion and sediment control measures that may be required during the construction phase of the project. Provide a statement of piping materials to be utilized in the conveyance system. Discuss security measures to be applied for ditches or pipes larger than 10 inches that pass beneath security fences.

c. Water Supply: Provide an explanation of the existing system including the type, capacity, condition, present water use and unsatisfactory elements of component parts for major extensions. For new systems, provide a complete description of the system including the type of materials for water mains, type of well, etc. For distribution systems, indicate design values for domestic and fire flow requirements, residual pressures, and elevation differentials. Also, include recommendations for new pipe sizes. Indicate any regulatory permits that may be required.

d. Sewers and Sewage Disposal Systems: Describe the existing system, including type, capacity, condition, flow, and unsatisfactory elements of component parts for major extensions. Provide recommendations for the degree of treatment necessary

based on effluent requirements and units necessary for treatment. Indicate new materials to be utilized for sewer systems and sewage treatment plants. Indicate any regulatory permits that may be required.

e. Roads, Driveways, Parking Areas, Walks and Railroads: Provide a brief description of the pavement section to be used and, as a minimum, provide justification including logical alternatives and rationale for selection of the best pavement section. Describe the type of traffic that will be prevalent to project site including traffic volumes, controlling wheel loads and types and/or classes of roads to be considered. The discussion shall also include a statement of general soil conditions, with a brief outline of soil exploration and testing performed.

f. Airfield and Major Pavement Projects: Provide justification for the selected pavement design used. Identify the logical alternatives and discuss the rationale used to determine the best pavement section. Pay careful attention to all factors such as criteria, cost, local conditions, availability of materials, drainage, etc. A brief description of the pavement section to be used shall be provided and, as a minimum, include the subsurface conditions and the method of analysis and design.

g. Fencing: List applicable security criteria for the project. Describe type, height, security clear zones, and justification for new fencing. Describe height and type of existing fence on or adjacent to the project site. Include a description of any special phasing required to maintain security during removal and installation of security fencing.

h. Environmental Pollution Control: A statement explaining expected environmental pollution and the proposed method of control. A detailed description will be necessary for those facilities directly related to controlling air and water pollution; such as sewage treatment plants, industrial treatment facilities, incinerators, smoke elimination facilities and other similar projects.

1.3 CALCULATIONS: The design of all Civil engineering aspects of the project shall be in accordance with the appropriate Navy design criteria or other criteria as required. Calculations supporting the design shall be submitted. All references, codes and design data used in the calculations shall be included and source indicated in the calculations.

1.2.3 DESIGN DRAWINGS: The following drawings shall be included and shall be developed to the extent indicated:

a. General Location Map: Show project location, haul routes, borrow areas, disposal areas, laydown and storage areas and plant sites. Show as much of the Activity as necessary to convey meaningful information to someone who has not visited the

installation. This drawing may also serve as a cover sheet and should include a vicinity map.

b. Existing Site and Demolition Plan: This plan should show all existing above and below ground site information, existing contours and spot elevations, and all demolition required to build the new project. All bench mark control points, markers or monuments shall be clearly referenced and described. The plan shall show accurate locations of borings and shall, if possible, be oriented so that North is to the top or to the left of the sheet. The plan shall be provided with graphic scales, keymaps, north arrow, datum plane and station coordinates of bench marks, and legend to define all symbols used. The new facility (building only) should be outlined (by broken line) at the proper location on the plan. All demolition should be shown (preferably with cross hatching) and completely described. Details, where necessary, should be provided on structures to be removed. Thicknesses of pavements to be removed (including thickness of pavement layers) should be described. Demolished features should NOT be shown on subsequent drawings.

c. Site Plan: This plan should show all new aboveground site features including all buildings and pavements, complete with dimensions, traffic flow patterns, parking layout and striping including handicapped parking requirements, joint layout of sidewalks and concrete pavement, fences, and all other structures and facilities. Location of new facilities should be referenced to existing, identifiable surface features. As a minimum, the following details (when applicable) should be referenced on this plan and be shown on the detail drawings:

(1) Flexible pavement section identifying wearing course and binder course (where required), tack coat, prime coat, base course and subgrade
(2) Rigid pavement section identifying paving reinforcement (where required), base course, and subgrade
(3) Flexible pavement overlays identifying wearing course, binder course, leveling course, tack coats and other details as appropriate
(4) Pavement repair details (i.e. utility crossings)
(5) Street profiles
(6) Sidewalk and jointing details
(7) Handicapped provisions and details
(8) Parking and other pavement markings
(9) Curb and gutter details
(10) Guard post details
(11) Fencing and gate details including security barriers for openings beneath fences
(12) All existing aboveground features which are altered by construction
(13) Joint layout plan showing the location of all joints, their types, spacing and a detail of each joint used.

(14) Marking plan showing the location of all pavement markings required for the project. Width and color of all markings shall be identified.

d. Grading and Storm Drainage Plan: This plan includes all existing and finish contours at maximum 1.0 foot interval, existing and finish spot elevations as necessary to insure proper drainage, ditches, existing and new storm drainage pipes with sizes, slopes and inverts shown, manholes, catch basins, curb inlets, headwalls and other necessary structures. Clearly indicate locations of security barriers on man passable pipes and ditches which pass under security fences. As a minimum, the following details (when applicable) should be referenced on this plan and be shown on the detail drawings:

(1) Storm drainage structure details including security barriers, where required
(2) Frames, grates and cover details
(3) Ditch/swale profiles and sections
(4) Detention/retention pond section and details
(5) Erosion protection details
(6) Headwall, endwall, mitered or flared end section details

e. Water and Sewer System Plan: This plan should show the overall layout of existing and new water and sewer lines with sizes indicated. The water system should include the approximate elevation of the existing lines and the location of all valves and hydrants. The sewer system should include the location of manholes and pump stations, the inverts and top elevations of all manholes and cleanouts, and slopes of lines. Building services should be coordinated with building plumbing drawings. Separation requirements for water and sewer lines should be checked on this plan and overall coordination of existing and new storm drainage, water, sewer, gas and underground electrical should be reviewed. As a minimum, the following details (when applicable) should be referenced on this plan and be shown on the detail drawings:

(1) Fire hydrant installation details
(2) Backflow preventer details
(3) Cleanout details
(4) Manhole, frames and cover details
(5) Thrust block details
(6) Pump station details
(7) Pipeline profiles (gravity sewers normally when site is very crowded with utilities, plus force main when required by State Permitting Agency)

f. Soil Boring Logs: The soil boring logs should be drawn with attention given to minimum lettering size. Logs should be referenced to the boring number in the plan sheet where shown. Soils should be identified in accordance with the Unified Soil Classification System. Standard penetration test blow counts, ground water table elevations, and the in-place moisture content of the soil layers shall be shown. Soil borings log elevations shall be referenced to true bench mark elevations shown on grading plan, and a note on the sheet shall indicate when and by whom the borings were taken.

g. Airfield and Major Pavement Plans: See Section 14 of SOUTHNAVFACENGCOM P-141 for requirements.

h. Other plans as required, i.e. sediment and erosion control plan (when more than 1 acre of ground is disturbed), construction phasing plan, irrigation systems layout and detail, etc.

2. GENERAL REQUIREMENTS FOR PREPARATION OF DRAWINGS

2.1 The following is a list of general requirements for the preparation of drawings for the civil engineering portion of the project:

a. SOUTHNAVFACENGCOM will furnish autocadd formatted, "D" size (34" X 22"), drawing files with SouthDiv title blocks to be used in the preparation of project plans.

b. The civil and site drawings shall be shown to an appropriate scale which will show all existing and new features clearly without undue clutter. It is desirable to use a scale which will allow placement of the entire site on a single sheet.

c. On small uncomplicated projects, one or more of the above plans may be combined, but never so that the plans will be crowded.

d. If possible, orient all drawings so that "north" is to the top or left of the sheet. Unless special conditions dictate, the orientation should be the same from sheet to sheet.

e. Show all new work in heavy, dark lines and existing items in light or dashed lines. (Poor quality will be rejected and a resubmission will be required).

f. All lettering should be legible when plans are reduced to half size.

3. DOS AND DON'TS

a. Do read your "Statement of Work" and ask questions if the scope of work is ambiguous.

b. Do consult with the Activity concerning site specific issues such as security requirements (especially security fencing and associated security clear zones), parking, handicap requirements, etc.

c. Do contact the appropriate regulatory agencies at the earliest opportunity to assure that their requirements are integrated into the design of the project. This is especially important with regards to stormwater management.

d. Don't hesitate to contact the Civil Engineering Branch at SouthDiv about any Design Criteria that is confusing.

e. Do respond to all review comments. Phone the reviewer if you disagree with or do not understand a review comment.

f. Do provide all calculations to support the design.

g. Don't reference other disciplines without being specific about the specific sheet or plan that is being referenced.

h. Do field verify your design.

i. Don't say "proposed", do say "new".

j. Don't show demolished features on any other plan except the "Existing Site and Demolition Plan".

k. Do provide the thickness (including layers) of any pavements to be demolished.

l. Do edit the guide specifications to suit the particular application.