CITY OF HOMER
HOMER, ALASKA

ORDINANCE 85-16

AN ORDINANCE ADOPTING A DESIGN CRITERIA MANUAL FOR STREETS AND STORM DRAINAGE

WHEREAS, any amendments to this manual must be approved by the Homer City Council.

NOW THEREFORE, the City of Homer ordains that a Design Criteria Manual is hereby created and adopted by reference as if included in the Homer City Code as follows:

DESIGN CRITERIA MANUAL
FOR
STREETS AND STORM DRAINAGE

APRIL 1985

CITY OF HOMER

ORDINANCE 85-16

EFFECTIVE DATE: SEPTEMBER 1, 1985

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INTRODUCTION

This manual is authorized and referenced by Chapter 11.04 of the Homer Municipal Code. It has been written to augment Chapter 11.04, entitled "Street Design and Construction Standards", by detailing specific design standards and methods in detail. The manual also provides a format more conducive to discussion and elaboration of design criteria than the municipal ordinance.

Where design criteria are not specifically addressed, in this manual or in Chapter 11.04, the criteria shall be established by reference to generally accepted engineering standards. For example, the primary source of geometric design criteria should be "A Policy on Geometric Design of Highways and Streets" (AASHTO, 1984); Supplemental standards may be obtained from "Guidelines for Urban Major Streets" and "Recommended Guidelines for Subdivision Streets", published by the Institute of Transportation Engineers.

SECTION 1.01
SPECIAL CONDITIONS FOR STREET DESIGN
HOMER, ALASKA

Street design in Homer, Alaska must accommodate a number of difficult conditions; special consideration must be given to such conditions in the design phase.

These special conditions may include some combination of the following:

- Steep slopes
- Irregular topography (e.g., low knolls, gullies, etc.)
- Deep, soft, saturated clay (with interbedded coal seams)
- Deep peat layers
- Abundant subsurface seepage
- Springs
- Low soil permeability (backfill, especially trenches for culverts or utility mains may act as "french drains", possibly leading to piping failures or other phenomena)
- Frost heaving and frost "boils"
- Glaciation
- High rates of erosion/sedimentation
- Unavailability of local structural fill material
- Need for snow storage

The City shall require the design engineer to address any or all of these conditions, and any other special problems likely to be encountered on the project site.

SECTION 1.02
ROAD AND STREET DESIGN FACTOR SUMMARY

I. PLANNING CRITERIA	MAJOR ARTERIAL	MINOR ARTERIAL	COLLECTOR: RESIDENTIAL	COLLECTOR: COMMERCIAL/ INDUSTRIAL	LOCAL
Access Function	Secondary	Secondary	Equal	Equal	Primary
Movement Function	Primary	Primary	Equal	Equal	Secondary
Spacing					
CBD	1/2 Mi.	1/3 to 1/2 Mi.	1/8 to 1/4 Mi.	1/8 to 1/4 Mi.	300 to 500 Ft.
Central City Outside CBD	1 Mi.	1/2 to 1 Mi.	1/4 to 1/2 Mi.	1/4 to 1/2 Mi.	300 to 500 Ft.
Fringe Area	1 to 5 Mi.	1 to 3 Mi.	1/2 to 1 Mi.	1/2 to 1 Mi.	
Travel Speed	25 - 45	25 - 45	20 - 30	20 - 30	15 - 25
ADT (Thousands)	10+	3.5 - 15	0.5 - 6	0.5 - 6	<1

ROAD AND STREET DESIGN FACTOR SUMMARY
(Continued)

II. DESIGN ELEMENT	MAJOR ARTERIAL	MINOR ARTERIAL	COLLECTOR: RESIDENTIAL	COLLECTOR: COMMERCIAL/ INDUSTRIAL	LOCAL
No. of Traffic Lanes	3 - 6	2 - 4	2	2 - 4	2
Min. ROW Width (Ft.)	100	100	60	70	60
Min. Curve Radius (Ft.)	700	600	500	500	150 (120 feet on hilly terrain)
Max. Grade (%)	6 (8<500')	8 (10<500')	10 (8-Curves, 12<500')	8 (6-Curves, 12<500')	10 (8-Curves, 12<500')
Min. Grade (%)	0.30	0.30	0.30	0.30	0.30
Min. Design Speed (MPH)					
Level/Rolling Terrain:	50	45	40	40	25
Hilly Terrain:	50	40	30	30	20
Min. Traveled Way Width (Ft.)	36	24	24	24	22
Min. Shoulder Width (Ft. each side)	8	6	4	4	3

SECTION 1.03
DESIGN REPORTS

A. General

Accompanying all street designs shall be a soils report, prepared according to the stipulations of Section 5.1, and a street design report containing, at minimum, the information detailed below.

B. Design Report Requirements

Design reports shall address, at minimum, the following:

1. Relationship of street to the Master Plan for Roads and Streets (i.e., whether it is shown on the Master Plan map or ties into a street shown on said map).

2. Functional classification of proposed street.

3. Design life of roadway.

4. Design speed.

5. Estimated average daily traffic at end of design life. (Attach trip generation calculations.)

6. Proposed roadway length.

7. Cross-section width and number of lanes.

8. Right-of-way width.

9. Maximum grades, and whether these exceed the standards of the City.

10. Approach grades at all intersections and whether these exceed City standards.

11. Maximum curvature, and whether curvature exceeds City standards.

12. Wetland status (i.e., whether Corps of Engineers permit is required).

13. Drainage patterns:

    a. Local drainage only, or, drainageways through the area.
    b. Estimated flows through drainageways and ditches.
    c. Method of disposing drainage downstream and mitigating downstream impact.

14. Structural section design calculations.

15. Number and types of traffic control devices required by Alaska Traffic Manual.

16. Illumination level calculations.

17. Design turning vehicles at intersection. (If intersection less than 75°, attach design calculations or graphical superposition of turning template on curve.)

18. Maximum and minimum depths of bury of existing or proposed utilities below roadway and/or side ditches.

19. Filter fabric specifications.

20. Pavement design calculation (if pavement is included).

21. Intersection sight distances. (Attach stopping sight distance calculations per Article 5.7.)

SECTION 1.04
DEFINITIONS

ADT - Average daily traffic, in vehicles per day.

Curb Cut - A curb cut is a special sidewalk and curb section that is designed to allow driveway or parking lot access when barrier curb is used.

Curb Return - A curb return is the curved portion of the curb which forms the corner at intersecting streets.

Detention Basin - A detention basin is used to store storm water on a temporary basis to reduce the peak flow.

Filter Fabric - Filter fabric, either woven or nonwoven, is a textile designed primarily to filter fine soil particles from ground water.

Filter Material - Filter material is selected sand or gravel which is used to filter fine soil particles from ground water.

Freeboard - The freeboard is the elevation difference between the design flow water surface and the top of the channel.

Primary Street - The primary street is the most important street usually carrying the heaviest traffic volume at a given intersection. The primary street is often the through street or is a street of higher classification, i.e. a collector or an arterial.

Secondary Street - The secondary street is the least important street at a given intersection usually carrying the lower traffic volume.

Storm Drain - A storm drain is a system of inlets and pipes which collect and transmit surface runoff water.

Subdrain - A subdrain is a perforated pipe system which intercepts and transmits ground water.

SECTION 1.05
STREET DESIGN CRITERIA

Article 5.1 Soils Requirements

A. Testhole Locations

The purpose of testholes is to collect sufficient data to allow engineer to determine soil conditions on project site as the basis for design. Testholes shall normally be spaced not further than 300 feet apart. Spacing greater than 300 feet may be approved if field samples indicate uniform soil conditions.

B. Testhole Depth

The depth of testholes shall be 8 to 10 feet below finished grade. Where peat is encountered, the depth of testholes shall be at least 4 feet below the bottom of peat. In areas where permafrost is expected, representative testholes up to 30 feet deep, or as adequate to determine the depth of permafrost, may be required.

C. Soils Report Requirements

Soils reports shall contain the following information:

1. Text

a. Project location and topography.
b. Brief geology of area involved.
c. Exploration method and equipment, including sampling equipment.
d. A brief description of the laboratory testing program including the name of the testing agency.
e. Subsurface conditions which include groundwater and seepage conditions, grouping of soils into major types, distribution of soil groups, and frost penetration if exploration was conducted during the freezing period. Soils shall be classified according to frost classification, the Unified Soil Classification System, and the U.S. Department of Agriculture soil type.
f. Conclusion and recommendations pertinent to the design of the proposed improvements including predicted frost action.

2. Testhole Logs:

a. Date of boring, testhole number, horizontal location (distance and offset), and elevation.

Where the existing ground is flat or of a uniform slope, the elevation requirement may be waived.

b. Ground water level recorded after stabilized and/or 24 hours.

c. Depth to top of each strata and bottom of testhole and/or refusal.

d. Soil moisture content (percent) at each sampling interval as well as the Atterberg limits of representative samples.

e. Visual soil classification of each strata in accordance with the Unified Soils Classification System. The classification letter designation and frost classification shall be noted.

f. The results of mechanical analysis performed, one for each typical soil group as described in the subsurface conditions section of the text. The testhole number and depth of sample shall be noted.

Article 5.2 Survey Requirements

A. Topographic Features

All topographic features, including trees and shrubs (if these would impact design or construction), shall be located within the area between the right-of-way centerline and a line located 20 feet inside the property line. Buildings and other major topographic features outside of this area shall also be located.

B. Elevations

1. Cross sections are required at 50-foot intervals along the centerline and where the slope of the ground profile changes. Elevations shall be noted to a point 50 feet from the right-of-way centerline and shall include the right-of-way centerline, the property lines and all obvious points where the slope of the ground changes.

2. Elevations are required for all driveways in cases of reconstruction of existing streets. Minimum requirements are elevations of the pavement edge parallel to the right-of-way centerline, elevations at the property line, and garage or carport floor elevations. In critical locations additional information may be required for design purposes. For new streets, future driveway locations should be specified.

Article 5.3 Vertical Design Requirements

A. For purposes of this manual, the following terrain classification system shall apply:

1. Level - grade range of 0 to 8 percent
2. Rolling - range of 8.1 to 15 percent
3. Hilly - grade of over 15 percent

B. Specific Criteria

1. The desirable minimum street grade is 0.40 percent and the absolute minimum grade is 0.30 percent.

2. The desirable maximum street grade is 6.0 percent. Absolute maximum grades are as specified in Chapter 11.04 of the Homer Municipal Code for respective functional/design classifications of streets, except for short distances. The maximum values for short distances (under 500 feet), are specified, but the use of such short sections shall be subject to the City Public Works Engineer's discretionary approval. Their use should be limited to hilly terrain and the steeper reaches of rolling terrain sections. In hilly areas, further increases are possible as specified below.

3. In hilly areas:

   a. Grades up to 15 percent will be allowed on short tangent sections not exceeding 100 feet in length.
   b. The maximum grade through a horizontal curve with a radius less than 150 feet shall not exceed 5.0 percent where the change in horizontal alignment exceeds 120 degrees.
   c. The maximum grade along the uphill tangent from a horizontal curve with a radius less than 150 feet shall not exceed 5.0 percent for at least 100 feet to allow for acceleration and braking.

4. The cross slope to crown on paved streets shall be 2.0 percent, and on gravel streets shall be 3.0 percent, intersections and superelevations excepted.

5. The grade of the primary street through the intersections shall not exceed 7.0 percent, unless otherwise approved by City Public Works Engineer.

6. The grade of the secondary street at intersections shall not exceed 4.0 percent within a distance of 30 feet from the back-of-curb, or edge of shoulder line, of the primary street.

7. The minimum grade around a curb return or other curve radius shall be 0.50 percent.

8. The desirable minimum Portland Cement Concrete valley gutter grade shall be 0.40 percent with an absolute minimum grade of 0.30 percent.

9. The minimum asphalt concrete valley gutter grade shall be 1.0 percent.

10. The desirable minimum ditch grade shall be 0.50 percent with an absolute minimum grade of 0.35 percent.

C. Cut and Fill Slopes

1. Cut slopes shall not be steeper than 2.0 feet horizontal to 1.0 feet vertical.

2. Fill slopes shall not be steeper than 2.0 feet horizontal to 1.0 feet vertical; if embankment height above ditch bottom is less than 5 feet, slope shall be not steeper than 3.0 feet horizontally to 1.0 feet vertically, unless otherwise approved or directed by the City Public Works Engineer.

3. In no case shall slopes exceed the angle of repose for the sloped material.

4. Slopes shall be located within rights-of-way, provided that slopes may be within slope easements if approved by the City Public Works Engineer.

D. Vertical Curves

1. Grade breaks shall be used where the algebraic difference in grade is 1% or less.

2. Changes of grade for an algebraic difference of more than 1% shall be obtained through the use of symmetrical vertical curves. Unless otherwise approved by the City Public Works Engineer, the length of vertical curve shall be determined by the following design speeds (see Figures 3 and 4):

Arterial Street	45 mph
Collector Street	40 mph (may be reduced to 30 mph in hilly areas)
Residential Streets	25 mph (20 mph in hilly areas)

3. Whenever possible, vertical curves shall be separated by a tangent of at least 25 feet.

E. Driveway Grades

Driveway grades shall be designed in accordance with Figure 7, Driveway Requirements, unless otherwise approved by the City Public Works Engineer.

F. Cul-de-sacs

The maximum grade of the cul-de-sac bulb measured in any direction shall not exceed 5 percent.

G. General Controls

The City Public Works Engineer will review each street or road design for conformance with the following "General Controls for Vertical Alignment," developed by the American Association of State Highway and Transportation Officials:

1. A smooth grade line with gradual changes should be strived for in preference to a line with numerous breaks and short lengths of grades.

2. The "roller-coaster" or the "hidden-dip" type of profile should be avoided. Such profiles generally occur on relatively straight horizontal alignment

   natural ground line.

3. Undulating grade lines, involving substantial lengths of momentum grades, should be appraised for their effect upon traffic operation. Such profiles permit heavy trucks to operate at higher overall speeds than when an upgrade is not preceded by a downgrade, but may encourage excessive speeds of trucks with attendant hazard to other traffic.

4. A broken-back grade line, two vertical curves in the same direction separated by short section of tangent grades, generally should be avoided, particularly in sags where the full view of both vertical curves is not pleasing.

5. On long grades it may be preferable to place the steepest grades at the bottom and lighten the grades near the top of the ascent, or to break the sustained grade by short intervals of lighter grade instead of a uniform sustained grade that might be only slightly below the allowable maximum. This is particularly applicable to highways with low design speeds.

6. Where intersections at grade occur on highway sections with moderate to steep grades, it is desirable to reduce the gradient through the intersection. Such a profile change is beneficial for all vehicles making turns and serves to reduce the potential hazards.

The City Public Works Engineer may require adjustment of design vertical alignment to meet these criteria.

Article 5.4 Plan, Profile and Specification Requirements

A. Plan and Profile Requirements - General

Street designs must be submitted to the City on 24"x 36" plan and profile paper; details to be presented in the plan and profile shall at minimum conform to the requirements of section (B) and (G) below. The City Public Works Engineer may require that additional information be provided on the plan and profile as he deems necessary.

B. Alignment and Plan View

The plan view shall at minimum present:

1. Point of curvature and point of tangency on all curves.
2. Horizontal curve data.
3. Right-of-way borderlines.
4. Centerline and stationing on centerline.
5. Existing and proposed driveway locations.
6. Existing streams or drainageways.

C. Monuments

All monuments on or near right-of-way or proposed street to be constructed shall be shown.

D. Utilities

Plan view shall show the location of all existing buried or overhead utilities within the right-of-way of the street to be constructed, or within 20 feet of said right-of-way. The plan view shall further locate all public utilities to be constructed prior to road improvements, if the street and utility improvements are phased concurrently. All manholes, valves, cleanouts, keyboxes, pedestals, and poles shall be shown.

E. Structures and Culverts

Plan view shall locate all existing structures within 50 feet of the right-of-way of the street to be constructed, and shall fix the location, size, and length of all existing or proposed culverts within the right-of-way.

F. Profile View

Profile view shall show all roadway grades, vertical curve data (including vertical point of curvature and vertical point of tangency), original ground profile at centerline, original ground profile at both right and left right-of-way edge, the profile of all existing water, sewer, and storm drain facilities (existing or proposed), and logs of all test borings.

G. Engineer's Stamp

Plans shall be signed and stamped by a civil engineer registered in the State of Alaska prior to approval by the City Public Works Engineer.

H. Specifications

All plans and profiles shall be accompanied by a bound set of project specifications, including all sections of the Municipality of Anchorage Standard Specifications applicable to the project, and including standard modifications as approved or specified by the City of Homer, and special provisions to govern improvement construction.

Article 5.5 Horizontal Design Requirements

A. General

The construction centerline will coincide with the right-of-way centerline unless otherwise approved. Approval to shift the construction centerline may be considered to attain the following objectives:

1. Reduction of retaining wall requirements;

2. Reduction of slope easement requirements;

3. Facilitation of intersection alignment;

4. Reduction of utility relocations.

B. Horizontal Curves

1. The radius of curvature along the centerline of the street shall not normally be less than:

Major Arterial Street	700 feet
Minor Arterial Street	600 feet
Collector Street	500 feet
Residential Street	150 feet

Larger radii may be required in some instances.

2. For steep hillside areas the minimum radius of curvature along the centerline of the residential streets shall be 120 feet with curve widening.

3. Streets shall be superelevated on curves; the superelevation rate shall be as appropriate to maintain design speeds, as listed in the Design Factor Summary. Rates of superelevation are to be obtained from AASHTO's 1984 "Policy on Geometric Design of Highways and Streets". Superelevations shall not exceed 6 percent. As a general rule transition to the superelevation section shall be obtained with 2/3 of the transition on the tangent and 1/3 on the curve. Superelevation transition lengths shall be determined by the degree of curve, design speed, and superelevation rate in accordance with recognized engineering standards.

4. The stopping sight distance shall be considered for horizontal curves (see Figure 6).

C. Curb Radii

Curb radii at intersections shall be specified in accordance with Figure 8, Curb Return Standards.

D. Cul-de-sacs

Cul-de-sacs shall be designed in accordance with Figure 9, Cul-de-sacs.

E. Curb Cuts

1. Curb cuts shall have a minimum curb opening width of 12 feet.

2. Residential areas the maximum curb opening width of a single driveway curb cut is 20 feet.

3. Curb cuts shall be located so that the nearest edge of a driveway fronting on an arterial or collector street is a minimum of 45 feet from the right-of-way line of any intersecting street. The nearest edge

of a driveway fronting on a residential street shall be a minimum of 25 feet from the right-of-way line of any intersecting street.

4. Access to arterial or collector streets will be discouraged and may be denied for any parcel of property which also has access onto a residential street.

5. The maximum curb cut width for commercial lot access to an arterial or collector street shall be 40 feet.

6. The total width of a curb cut for a lot shall not exceed two-fifths of the lot frontage which faces the street, except for zero lot line development where the combined curb cut shall not exceed two-fifths of the combined lot frontage.

F. Driveways (other than curb cuts)

Geometric standards for driveways are as specified in the DOT manual.

G. Trip Generation Rates

Unless otherwise directed the average daily traffic count (ADT) shall be estimated using the following criteria:

Housing Type	ADT per Unit
Single Family Detached	8.2
Two-Family (duplex, townhouses)	8.0
Multi-Family (townhouses, apartments)	7.3
Mobile Home	5.5

A more comprehensive listing of trip generations is listed in Appendix 1.

H. Utilities

1. Should utility line extensions be necessary within the right-of-way of a paving project to provide service, the utility company shall be contacted in writing during the design phase to coordinate the necessary construction prior to paving.

2. Where water and sewer connection are required for unserviced lots, the property owner(s) shall be contacted by letter during the design phase to coordinate construction prior to paving. In residential areas, connections may be provided to unserved lots. Where development plans are not known, the connections shall be sized in accordance with the recommendations of the City of Homer.

I. General Controls

The City Public Works Engineer will review each road or street design for the following "general controls for horizontal alignment" developed by the American Association of State Highway and Transportation Officials:

1. Alignment should be as directional as possible, but every effort should be made to preserve developed properties and community values. On new urban highways, a flowing line that conforms to the natural contours is preferable aesthetically to one with long tangents that more heavily scar the terrain. With flowing alignment the construction scars can be kept to a minimum and natural slopes and plant growth can be preserved. Such design is desirable both from a construction and maintenance standpoint. In general, the number of short curves should be kept to a minimum. Winding alignment, composed of short curves, should be avoided since it tends to cause erratic operation and accidents.

2. In alignment predicated on a given design speed, use of the maximum degree of curvature for that speed should be avoided wherever possible. The designer should attempt to use generally flat curves, retaining the maximum for the most critical conditions. In general, the central angle of each curve should be as small as the physical conditions permit, so that the highway will be as directional as possible.

3. Consistent alignment should always be sought. Sharp curves should not be introduced at the ends of long tangents. Sudden changes from areas of each curvature to areas of sharp curvature should be avoided. Where sharp curvature must be introduced, every effort should be made to approach it with successively sharper curves.

4. For small deflection angles, curves should be sufficiently long to avoid the appearance of a kink. Curves should be at least 500 feet long for a central angle of 5 degrees, and the minimum length should be increased 100 feet for each 1-degree decrease in the central angle.

5. Sharp curvature should be avoided on high, long fills and elevated structures. In the absence of cut slopes, shrubs, trees, etc., above the roadway, it is difficult for drivers to perceive highway alignment and sharpness of curvature and adjust their operation to the conditions.

6. Caution should be exercised in the use of compound circular curves. Preferably their use should be avoided where curves are sharp. Compound curves with large differences in curvature introduce the same problems that arise at a tangent approach to a circular curve. Where topography or right-of-way restrictions makes their use necessary, the radius of the flatter circular arc (R_1) should not be more than 50 percent greater than the radius of the sharper circular arc (R_2), (R_1 should not exceed 1.5 R_2). A several-step compound curve on this basis is suitable as a form of transition to sharp curves. A spiral transition between flat curves and sharp curves is even more desirable, although spirals are not normally used in the State of Alaska.

7. Any abrupt reversal in alignment should be avoided. Such a change makes it difficult for a driver to keep within his own lane. Also, it is difficult to superrelevate both curves adequately, and erratic operation may result. A reversal in alignment can be designed suitably by including a sufficient length of tangent between the two curves for superelevation runoff, or preferably an equivalent with spiral curves.

8. The "broken back" arrangement of curves (short tangent between two curves in the same direction) should be avoided. Except on circumferential highways, most drivers do not expect succeeding curves to be in the same direction, the preponderant condition of succeeding curves in opposite directions developing a subconscious habit in drivers to follow them. Also, broken back alignment is not pleasing in appearance. Use of spiral transitions wherein there is some degree of continuous superelevation, is preferable for such conditions. The term "broken back" usually is not applied when the connecting tangent is of considerable length, say 1,500 feet or more. But even in this case the alignment will not be of pleasing appearance when both curves are clearly visible for some distance ahead.

9. To avoid the appearance of inconsistent distortion, the horizontal alignment should be coordinated carefully with the profile design. General controls for this coordination are discussed under a following heading of Combination of Horizonal and Vertical Alignment.

The City Public Works Engineer may require adjustment of design horizontal alignment to meet these criteria.

Article 5.6 Excavation and Backfill

A. General

1. Except as otherwise described in this section, excavation and backfill requirements shall be in accordance with the Standard Specifications of the Municipality of Anchorage.

2. Where soils investigations show that organic material is present within the proposed roadway prism, the plans shall call for its removal unless surcharging or other provisions have been approved.

B. Structural Design

1. Where frost susceptible soils are encountered in the subgrade, design criteria for frost conditions shall be used to determine the combined thickness of leveling course and subbase. The frost design reference for street improvements is the Corps of Engineers Manual TMS-818-2(EM1110-1-306) Pavement Design for Frost Conditions, 15 May 1962.

The primary basis for design is the Reduced Subgrade Strength Method; however, the results of the Limited Subgrade Frost Penetration Method should be considered for F3 and F4 soils. Design nomographs assume the use of non-frost susceptible material (less than 3% by weight finer than 0.02 mm) as backfill. Where the backfill is frost susceptible material, allowances should be made by the designer.

For design purposes, the frost classification system is as follows:

Group	Description
F1	Gravelly soils containing between 3 and 20 percent finer than 0.02 mm by weight.
F2	Sands containing between 3 and 15 percent finer than 0.02 mm by weight.
F3	(a) Gravelly soils containing more than 20 percent finer than 0.02 mm by weight; (b) sands, except very fine silty sands, containing more than 15 percent finer than 0.02 mm by weight; (c) clays with plasticity indexes of more than 12; (d) varved clays existing with uniform subgrade conditions.
F4	(a) All silts including sandy silts; (b) very fine silty sands containing more than 15 percent finer than 0.02 mm by weight; (c) clays with plasticity indexes of less than 12; (d) varved clays existing with nonuniform subgrade conditions.

Method 1: Limited Subgrade Frost Penetration Method

The procedure to determine the design thickness by the Limited Subgrade Frost Penetration Method is as follows:

a. Estimate the average moisture contents in the base and subgrade (see sketch, Figure 12) at the start of the freezing period and the dry weight of the base.

b. From Figure 11 determine the frost penetration "a" which will occur in a base material of unlimited depth beneath a bituminous pavement kept free of snow and ice. The Air Freezing Index for Homer, based on average daily temperatures for the three coldest winters in 30 years is 1,850 frost degree days.

c. Compute the base thickness "c" (see sketch, Figure 12) required for zero frost penetration into the subgrade.

d. Compute "r" by dividing the water content of the subgrade by the water content of the base. For design purposes the maximum value for "r" is 2.

e. After computing "c" and "r" use Figure 12 to determine the design base thickness "b" and the allowable frost penetration "s". For design purposes "b" should not exceed 72 inches.

1. Where a high water table or a high soil moisture content occur with F3 and F4 soils, a filtration type fabric should be considered at the bottom of the excavation to keep the base from being contaminated by frost susceptible material.

2. Abrupt changes in subbase thickness shall be avoided. Transitions shall be used to minimize tendencies toward step displacement and interference with surface drainage.

Method 2 - Reduced Subgrade Strength

This design criterion assumes frost will penetrate into subgrade, reducing capacity of subgrade during spring breakup. Generally, this method permits less combined depth of pavement and base than Limited Subgrade Frost Penetration Method. Provides sufficient thickness to protect against breakup at that time. However, for F4 soils it is generally not recommended that this method be used unmodified except in low volume roads; heaving may be excessive.

Minimum frost overlay may be obtained from choosing traffic index and entering chart on Figure 10.

TYPE OF FACILITY	TRAFFIC INDEX
Minor residential streets and cul-de-sacs.	4
Average residential streets.	4.5
Residential collectors and minor or secondary collectors.	5
Major or primary collectors providing for traffic movement between minor collectors and major arterials	6
Farm-to-market roads providing for the movement of traffic through agricultural areas to major arterials.	5-7
Commercial roads (arterials serving areas which are primarily commercial in nature).	7-9
Connector roads (highways and arterials connecting two areas of relatively high population density).	7-9
Major city streets and thoroughfares.	7-9
Streets and highways carrying heavy truck traffic. This would include streets in heavily industrialized areas.	9+

Alternate Methods (Conventional Design)

The designer may also examine as alternate design methods other generally accepted engineering methods. Examples of such methods (for both subbase and structural pavement design) include the California Bearing Ratio method, the Hveem stabilometer method, AASHTO interim method, Asphalt Institute method, the State of Alaska DOT/PF 1982 method.

In all cases the design engineer's paramount responsibility is to achieve sound structural designs. While economy is to be encouraged, it shall not provide justification for inferior design. The burden of proof shall be on the design engineer to demonstrate that the structural design method chosen should provide a stable roadbed, and specifically should according to test results and their interpretation via generally accepted engineering methods withstand the deleterious effects of frost penetration, spring thaws, and saturated subgrades.

Acceptance of alternate design methodologies is discretionary; approval or disapproval will be made by the City Public Works Engineer.

Article 5.7 Street Section

Street widths and cross-sections, as specified in Chapter 11.04 of the Homer Municipal Code, are depicted in Figures 1 and 2.

Article 5.8 Street Lighting

A. General

1. Streets to be constructed shall include roadway lighting in conformance with the standards and methods detailed below.

2. For design standards and criterion not listed below, the source of such standards and criteria shall be the "American National Standard Practice for Roadway Lighting", published by the Illuminating Engineering Society.

3. As an overall philosophy, the purpose of roadway lighting is to provide the motorist and the pedestrian adequate night-time visibility for safe, efficient use of the traffic facilities. The location of luminaires at intersections, the uniformity of light on the roadway surface, the effect of glare, and the illumination intensity are of primary importance to the motorist and should constitute the main concern of the designer in establishing a highway illumination system.

B. Techniques of Lighting Design (General Discussion)

Accepted methods of lighting design allow specified illumination levels to be achieved by use of various alternative design elements. Optimal design is achieved by analysis of alternates in lamps, luminaires, mounting heights, pole spacings, power consumption, etc. The design of street lighting installation is a process of utilizing known photometric characteristics of a selected lamp and luminaire in a trial-and-adjust process of assumed luminaire locations, for which a calculation is made of the average level of illumination and distribution of light over the area to be lighted. For each lamp-luminaire combination, there are manufacturer's photometric data which include footcandle charts showing the contours of various horizontal footcandle values over the area illuminated by that unit. These should be used to check luminaire positions that produce the calculated average illumination and uniformity ratio as related to the distribution of light over a given segment of pavement area (a check of uniformity).

C. Levels of Illumination

1. Generally recommended values for average maintained horizontal footcandles (HFC) of roadway (and abutting sidewalk or bikeway) illumination are as follows:

Roadway and Walkway Classification	Zoning District: Commercial or Industrial	Zoning District: Residential
	Average Maintained HFC	
Vehicular Roadways:		
Arterials	2.0	1.0
Collectors	1.2	0.6
Local	0.9	0.4
Sidewalks	1.0	0.4
Bikeways	2.0	0.5

All streets to be constructed within commercial or industrial areas shall be required to meet these standards. In residential areas, the developer may, at his opinion, elect to construct street lights in accordance with standards, provided that street lights shall be provided at all intersections connecting with arterial or collector streets in accordance with section 3 below.

2. The uniformity ratio, defined as the ratio of average maintained illumination to minimum maintained illumination, shall be no greater (poorer) than 3:1 on commercial or industrial streets, and no greater than 6:1 on residential streets.

3. Illumination within intersection areas (generally the area defined by connecting the points of curvature of the intersection approaches) shall be equal to or greater than the sum of the recommended levels of the two intersecting streets, provided that the average illumination level shall be at least 50 percent above the highest average illumination level required on the approach roadways.

D. Operation

Each light, or system of lights operated from a load center, shall be operated by a photoelectric cell as a switching device.

E. Luminaire Heights

The luminaire mounting height (distance from roadway surface to luminaire) is a function of the lamp intensity, refractor distribution, and roadway width. However, no luminaire should be less than 30' above the roadway due to the increased glare at low mounting heights. (The width of roadway is the distance between edges of traveled way including the center median on divided highways). Mounting heights should be in five-foot increments and should be the same (± 2 ft.) for each illuminated intersection or walkway. Normal mounting height is 40 feet for most installation.

F. Pole Location

1. Lateral Location of Lighting Unit

Light standards should be placed laterally 15' from the edge of any traveled way but not less than 2' from shoulder or 6' from edge of traveled way unless the right-of-way is of insufficient width for such positioning, in which case the standard should be placed adjacent to the right-of-way line. The luminaire should be over the approximate edge of traveled way to which it applies on uncurbed sections and over the face of curb on curbed sections.

2. Longitudinal Location of Lighting Units (Intersections)

Lighting units should be placed on the far right of the intersection for the major traffic flow. See Figure 17. Such a location provides an increasing level of illumination through the intersection where conflicts occur. Near right illumination should not be used on any approaches as such a configuration tends to blind the driver and place the actual intersection with its conflicts in relative darkness. Lighting units should be placed equidistant each side of the intersection with sufficient spacing so as to provide the desired level of illumination in the intersection. At channelized intersections, a minimum of two lighting units should be used so that the near left unit provides illumination of curb faces in the intersection.

G. Design of Luminaires

Luminaires shall be IES Type II or III medium distribution cut-off or semi-cutoff, unless otherwise approved or specified by the City Public Works Engineer.

Article 5.9 Intersection Design

A. Intersection Locations

The philosophy of intersection location differs somewhat between local streets as opposed to collectors, arterials, and some local commercial streets.

1. Local Streets

It is undesirable to encourage through-traffic movement on local streets. Within a subdivision development of local streets, it is desirable to use tee intersections, at spacings not less than 200 feet. However, local streets which terminate on arterials shall be aligned with existing tee intersections, if possible, to form four-way intersections.

2. Collectors and Arterials

Intersections on collectors and arterials should be spaced at even intervals; not less than 600 feet on major arterials, 300 feet on minor arterials and 200 feet on collectors.

As a general note, the number of intersections created by any given subdivision development should be minimized.

B. Sight distance at Intersections

1. Level grades. For two-lane intersecting roadways, the minimum sight distance (defined as available for a vehicle stopped on a cross road to see the approaching vehicle without obstruction, and conversely, the distance of unobstructed view by the approaching vehicle to the vehicle stopped at intersection) is defined as follows:

a. Intersection of local street with local street. Minimum sight distance shall be 150 feet along each approach street on level or rolling terrain (250 feet preferred); minimum sight distance for hilly terrain shall be 125 feet (200 feet preferred).

b. Intersection of local street with collector street. Minimum sight distance along the collector street shall be 325 feet on level or rolling terrain (400 feet preferred), and 200 feet on hilly terrain (300 feet preferred).

c. Intersection of collector street with collector street. Minimum sight distance along each collector street approach shall be 325 feet on level or rolling terrain (520 feet preferred), or 200 feet on hilly terrain (390 feet preferred).

d. Intersection of collector street with minor arterial street. Minimum sight distance along the collector street approach shall be 325 feet level or rolling terrain (520 feet preferred) or 200 feet on hilly terrain (390 feet preferred). Minimum sight distance along minor arterial approach shall be 400 feet on level or rolling terrain (765 feet preferred) or 325 feet on hilly terrain (595 feet preferred).

e. Intersection of minor arterial with minor arterial street. Minimum sight distance along each approach shall be 400 feet on level or rolling terrain (765 feet preferred) or 325 feet on hilly terrain (595 feet preferred).

NOTE: Preferred sight distances based on time required for design vehicles to cross roadway; minimums are based on stopping sight distance on level grades for vehicles approaching at design speed. The City Public Works Engineer may require that the design be based on preferred sight distance, if found necessary for safety purposes.

For purposes of calculation, the sight distance shall be measured along a straight line from a point described as the intersection of the right-of-way centerlines with a point on the centerline of the approach street for which sight distance is specified.

2. Effects of grades. The design engineer shall be required to provide an increase in minimum sight distance for downgrades approaching an intersection, if the stopping sight distance exceeds minimum specified sight distance. The design engineer shall be required to calculate the stopping sight distances for through-street approaches, or both approaches at local street/local street intersections. The stopping sight distance (SSD) in feet is determined by the formula:

$$SSD = 1.47PV + \frac{V^2}{30(f \pm g)}$$

where:

V = Design speed in miles per hour (determined from design factor summary)

P = Perception-reaction time in seconds (2.0 minimum, 2.5 recommended or required at the City Public Works Engineer's discretion)

f = Coefficient of friction for wet pavement (Note: standard design values are based on paved surfaces. No adjustment is allowable for gravel surface because of the lack of standard data for gravel coefficient of friction and the probability of eventual pavement.)

g = Percent of grade divided by 100 (+ for upgrade; - for downgrade)

For determining "f" values, the following table shall be used:

	Design Speed (mph)						
	20	25	30	35	40	45	50
Coefficient of friction "f"	0.40	0.38	0.35	0.34	0.32	0.31	0.30

3. If an intersection location specified by plat cannot accommodate the sight distances specified above, this shall not constitute grounds for a waiver of said requirements. The City Public Works Engineer may require relocation of the intersection to a location that can accommodate the required sight distances, and require that the subdivision by replatted accordingly, prior to approval of improvements.

C. Corner Radii at Intersections

The minimum corner radius (defined as the radius of the traveled way edge, or the curb return radius if applicable) shall be in accordance with the specifications detailed below:

1. The minimum corner radius for local streets intersecting at ninety degrees shall be 20 feet. If local streets intersect at a skewed angle, the corner radius shall be determined to accommodate the turning path of BUS design vehicles with minimal encroachment on shoulders or opposing lanes.

2. The minimum corner radius for intersections of local streets with collector streets, or for the intersection of two collector streets, shall be 25 feet, if the streets intersect at ninety degrees. If the angle of intersection is not ninety degrees, the corner radius shall be designed to accommodate

SU design vehicles with minimal encroachment on shoulders or opposing lanes.

3. The minimum corner radius for intersections of collector streets with arterials shall be 30 feet, if the streets intersect at ninety degrees. If the angle of intersection is not ninety degrees, the corner radius shall be designed to accommodate SU design vehicles with minimal encroachment on opposing lanes; however, in the case of commercial/industrial collectors, the corner radius shall be designed to accommodate WB40 design vehicles, unless otherwise approved by the City Public Works Engineer.

4. The intersections of two arterials shall be designed to accommodate WB50 design turning vehicles with minimal encroachment on shoulders or opposing lanes.

5. The design vehicles referenced in (1) through (4) above are described by the text "A Policy on Geometric Design of Highways and Streets", published by the American Association of State Highway and Transportation Officials (AASHTO), 1984. This reference shall be considered the primary source of design criteria, supplemental to the criteria detailed above, for intersection design.

6. If an intersection is being created by extension of a new street to or from an existing street, the City Public Works Engineer may require that the design engineer submit plan and profile information on the existing street to determine whether the sight distance requirements are met.

Article 5.10 Sidewalks, Curbs and Gutters

A. Gravel

Sidewalks are not a mandatory requirement to accompany street improvements (although such requirements can be specified by the Homer Advisory Planning Commission in some cases, particularly when conditional use permits are required). If sidewalks are constructed on public rights-of-way, they shall meet the standards outlined below.

B. Structural Section

Sidewalks shall consist of 4 inches of nonreinforced portland cement concrete, constructed atop a base consisting of a minimum of 24 inches of classified fill (as defined by the City of Homer). If there is a likelihood that compaction of the base material would, because of moisture conditions cause subgrade material to invade or "pump", into the structural section, a geotextile fabric shall be installed to separate classified fill from subgrade.

C. Construction Requirements

The designer shall specify that construction methods and materials, unless otherwise specified, shall be in accordance with the City of Homer Standard Specifications.

D. Sidewalk Widths

A minimum width of 5 feet shall be required if sidewalks are installed on local streets, or 6 feet if placed next to curbs. Along collector or arterial streets, the minimum width shall be 6 feet, or 8 feet if placed next to curb.

E. Sidewalk Grades

Sidewalk grades shall not exceed 8% unless otherwise approved by the City Public Works Engineer. A handrail may be required in cases where grades in excess of 8% are allowed.

F. Border Areas (Sidewalk to Traveled Way Edge, and Sidewalk to Property Line)

1. The designer shall allow space between the sidewalk and the abutting property line for placement of shallow-buried utility services, keyboxes, property stakes, construction forms, and fences. The amount of space required in many cases will depend on the site topography and the road's backslopes. The border area to be used shall be determined by the City Public Works Engineer in consultation with the design engineer, and the required border thus determined may control the horizontal location of the sidewalk.

G. Sidewalks Outside Right-of-Way

Nothing in these specifications shall prevent the construction of sidewalks inside property lines, provided that, if a sidewalk is parallel and proximal to a public road, the sidewalk should be designed to match the probable location of sidewalks on adjacent properties; the property owner should also dedicate a sidewalk easement.

H. Drainage

If roadway drainage is accomplished by use of open ditches, and drainage modifications would not accompany sidewalk construction, then the sidewalk shall be detached from the roadway, such that the ditch is between the sidewalks and roadway. The City Public Works Engineer may allow the sidewalk to be placed contiguous to or slightly offset from the roadway on such open-ditch roadways (i.e., "rural" street sections) if the sidewalk design does not interfere with the water-shedding function of roadway crown and if the ditch can be relocated further away from the roadway, such that drainage is not impaired.

In other cases, the street much normally be designed with a curb and gutter section if sidewalks are installed. If curbs and gutters are used, the curb and gutter types shall be as detailed in the Municipality of Anchorage Standard Specifications (Standard Details); however, rolled curb and gutter will be allowed only on local residential streets, subject to approval of the City Public Works Engineer. Ramps shall be provided at all curb returns, in accordance with the Municipality of Anchorage Standard Details.

Article 5.11 Bikeways

A. General

Bicycle paths are not mandatory development requirements. If they are constructed in public right-of-way, they shall meet the standards outlined below.

B. Structural Design

Bicycle paths shall have a minimum of 1-1/2" AC pavement, atop 2" levelling course per City of Homer Standard Specifications. Depth of subbase shall be designed in accordance with Section 1.05, Article 5.5 of this manual.

C. Geometric Design

Geometric design of bikeways shall be in accordance with the publication entitled "Guide for the Development of New Bicycle Facilities" (1981) published by the American Association of State Highway and Transportation Officials. Design shall be subject to City Public Works Engineer's approval.

SECTION 1.06
STORM DRAIN DESIGN CRITERIA

Article 6.1 Drainage Design Criteria

A. Storm Drains

1. Materials used for storm drains shall conform to the Standard Specifications of the City of Homer.

2. The minimum depth of cover shall be four feet measured from the street, or ground, surface to the top of the pipe. If this requirement cannot be met, measures may be required for pipe diameters less than 30 inches to prevent the development of ice within the conduit.

3. The minimum diameter of any storm drain shall be 12 inches, except the catch basin leads may be 10 inches.

4. Storm drains shall be sized by the use of the Manning equation (see Figure 14).

5. Surcharging of systems will not normally by allowed for the design of storm drains.

6. In no case shall the hydraulic gradient be higher than 0.5 feet below the elevation of inlet grates and manhole covers.

7. The minimum allowable pipe flow velocity shall be 2.0 feet per second.

8. The minimum pipe grade shall be 0.30 percent.

9. The alignment between manholes shall be a straight line. Curves may be allowed for large diameter pipes if approved by the City Public Works Engineer.

10. The maximum allowable pipe flow velocity shall be 13 feet per second.

B. Manholes

1. Manholes shall be located at major junction points, changes in vertical or horizontal alignment, and changes in pipe size or shape.

2. The spacing of manholes shall not exceed 400 feet for pipe 48 inches or less in diameter. For pipes larger than 48 inches the spacing will be handled on an individual basis.

3. The minimum allowable drop between pipe inverts across a manhole shall be 0.05 feet.

4. Manholes located within street right-of-ways shall be located 3.0 feet north or east from the right-of-way centerline. Manholes located within storm drain easements shall be located midway between the center and the north or east boundary of the easement.

C. Inlets

1. The maximum spacing of inlets along the gutter shall be 1,100 feet. Closer spacing may be required to insure that gutter flows do not exceed the gutter capacity.

2. Where storm drains are available to an area, inlets rather than valley gutters will normally be required at intersections.

3. If the standard inlet is of insufficient size to accept design flows, additional inlets may be required. Non-standard inlets of greater capacity may be allowed on an individual basis.

4. Where inlets are installed in unpaved areas, an asphalt concrete pad shall be placed around the inlet. The asphalt pad shall measure at least 2.5 feet from the center of the inlet to the outside of the pad.

D. Subdrains

1. Subsurface drainage facilities shall be provided when in the opinion of the design engineer, or in the opinion of the City Public Works Engineer, such facilities are necessary.

2. Subdrains shall be constructed of perforated pipe surrounded by filter material. Filter fabric may be allowed between the trench walls and the filter material, in the practice of wrapping filter fabric directly around the pipe will be allowed in road sections.

3. A standard cleanout or manhole shall be provided at the upstream end of all subdrain lines.

4. Storm drains may upon approval of the City Public Works Engineer, be perforated to provide subsurface drainage as a secondary function; however, storm drain shall, in such cases, be oversized in accordance with the direction of the City Public Works Engineer.

5. Although an exact procedure for determining subsurface flow quantity is not established, an estimate of flow should be made by examination, of the water table elevation and the ability of the surrounding soils to transmit water at the trench walls.

6. No minimum velocity for flow needs to be maintained in a subdrain unless it also serves as a storm drain in which case the storm drain design criteria will govern.

7. The minimum pipe diameter for subdrains shall be 6 inches.

8. Materials used for subdrains shall conform to the Standard Specifications of the Municipality of Anchorage.

E. Outfalls

1. When the outfall is from a pipe or paved channel to a natural unprotected channel, an energy dissipator may be required for protection against erosion. If the natural channel is subject to flooding, the outfall shall be protected by the use of a headwall, gabions, or other suitable means.

2. The invert elevation of a storm drain outfall shall be a minimum of 1 foot above the normal water surface elevation of streams or lakes to provide storage for icing accumulations unless otherwise approved.

3. Icing control devices may be required for outfalls.

4. A device to remove sediment and separate oil and grease from storm waters is required at storm drain outfalls into lakes, rivers or streams.

F. Culverts

1. Culverts under driveway entrances shall have a minimum inside diameter of 18 inches.

2. Culverts under a public road shall have a minimum inside diameter of 24 inches.

3. Installation of icing control devices may be required.

4. Where possible culverts shall be designed so as to have neither end submerged.

5. Culverts operate under inlet control or outlet control. The size of a culvert shall be computed using both methods and the larger computed size used for design purposes.

6. Materials used for culverts shall conform to the Standard Specifications of the Municipality of Anchorage.

G. Open Channels

1. The uses of open channels will include the following:

   a. Rerouting or realignment of an existing stream.

   b. When a drainage improvement is to be built in more than one phase, a channel may be allowed on a temporary basis until such time as full drainage improvements are developed.

   c. A road ditch for a rural street section.

2. The minimum channel side slope shall be two horizontal to one vertical (2:1) with a minimum invert width of 3 feet. Side slopes shall be seeded from the top of bank down to the normal channel flow depth to help in preventing erosion.

3. The maximum flow velocity allowed in a channel shall be such that no erosion or scouring will occur to the channel sides or bottom for flows up to and including the design storm flow. This scour velocity will be determined by soil conditions of the unlined channel. Where channel lining or erosion control devices are used, the design will be evaluated on a case by case basis.

4. Open channels shall be designed by use of the Manning equation (see Figure 14).

5. The minimum allowable freeboard is 1 foot.

Article 6.2 Runoff Prediction

A. Basis of Runoff Prediction

1. The basis of runoff predictions for major waterways in Homer is the City of Homer's "Drainage Management Plan" (CH2M-Hill, 1979) and "Revised Drainage Management Plan" (Quadra 1982). Drainage facilities for the designated waterways and/or watershed shall be designed to carry the flow quantities specified in these documents.

2. The Rational Method may be used for small areas of 5 acres or less, and for areas where the average basin slope exceeds 20%, in areas not covered by the drainage management plans.

B. Frequency of Occurance

1. Mapped Watercourses

   Design calculations for watercourses as designated in the Drainage Management Plan shall be based on a 25-year or 50-year recurrence interval as specified in the reports.

2. 10-Year Storm Facilities

   Design calculations for pipes greater than 24 inches shall be based on a minimum 10-year return period, except as specified in (1) above.

3. 5-Year Storm Facilities

   Design calculations for pipes 24 inches or smaller shall be based on a minimum 5-year return period, except as specified in (1) above.

4. The design capacity of open ditches shall be determined as follows:

   a. When rerouting or realigning existing streams, the channel capacity shall be based on a 100-year return period.
   b. A temporary open ditch shall be designed to contain the design flow of the proposed permanent pipe system.
   c. The capacity of a roadside ditch shall be based at minimum on a 5-year return period, provided that the minimum ditch standards as specified in the rural section cross-section shall be adhered to.

5. A snowmelt component will not be used when determining design flows for pipe size purposes.

C. Miscellaneous

1. A nomograph for determining the time of overland flow is shown as Figure 16.

2. Hydrologic calculations shall be based on accepted engineering procedures, as found in the literature.

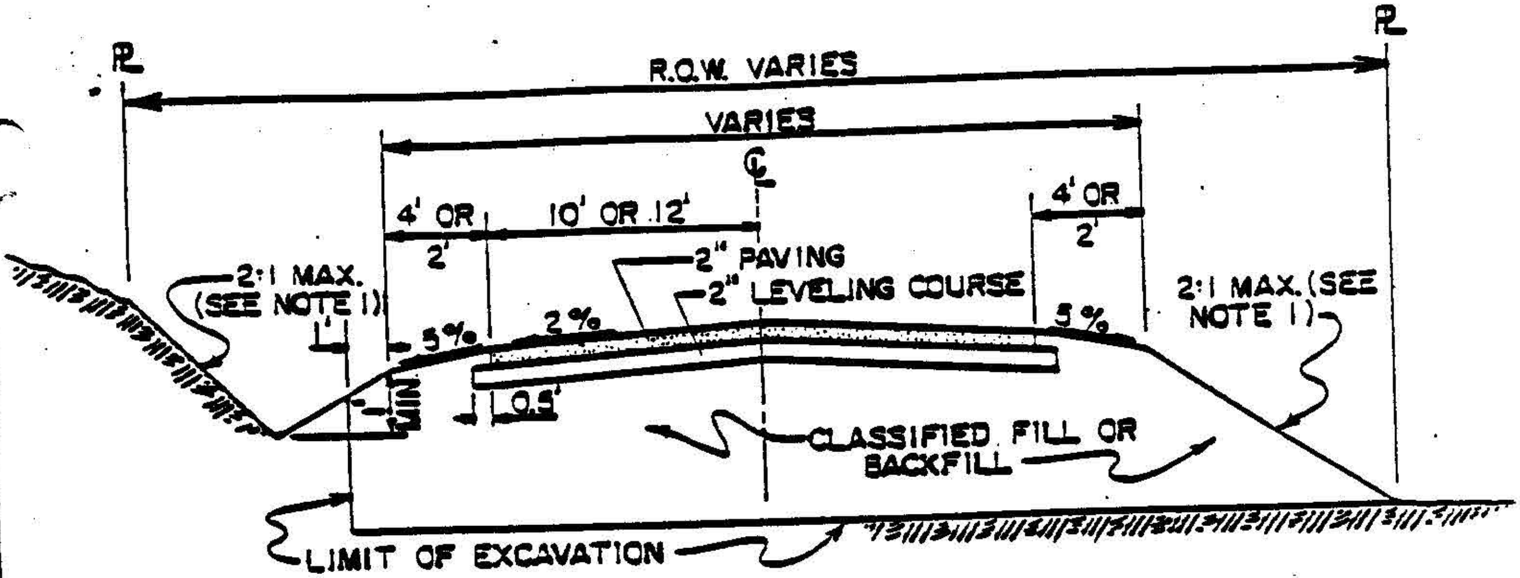
SECTION 1.07
WAIVERS

Municipal design criteria has been established to provide minimum standards for streets and storm water collection facilities. The engineer, however, remains responsible for identifying and resolving the specific problems associated with his design.

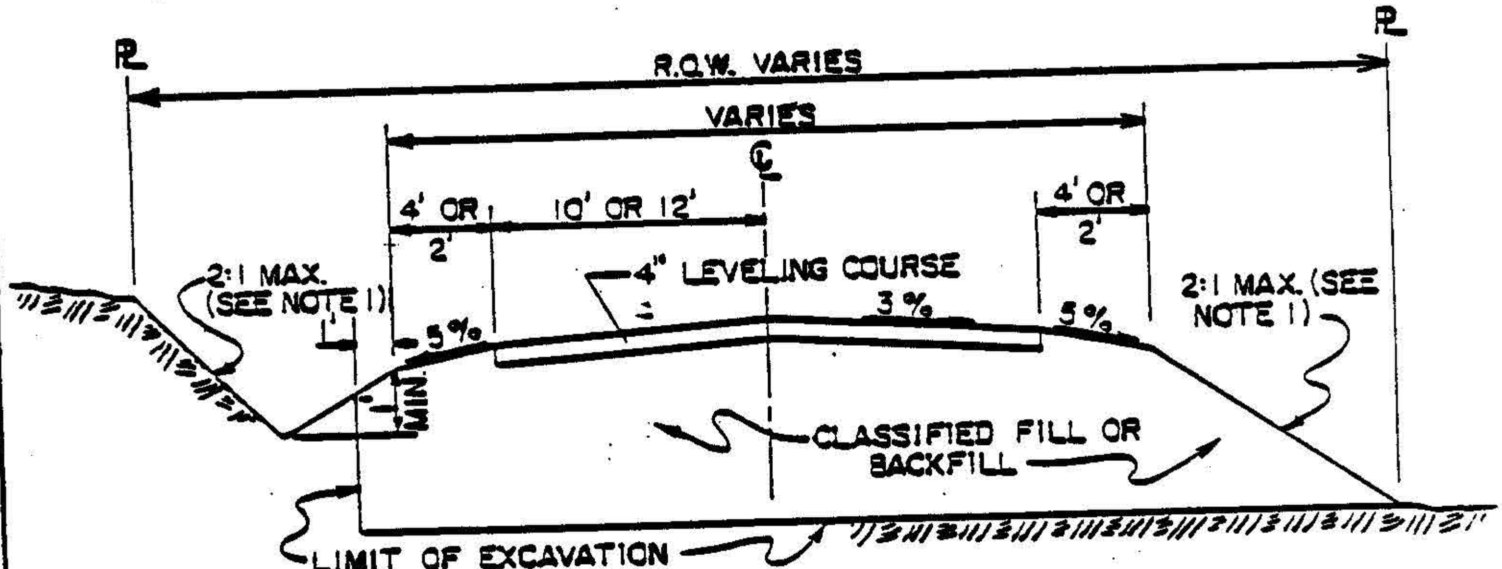
The City Public Works Engineer may waive specified design criteria on a case by case basis. Requests for waiver shall be in writing and shall include the reasons why the specified criteria will not work and the basis of the proposed change.

SECTION 1.08

DETAILS, TABLES AND NOMOGRAPHS



TYPICAL SECTION - 20'/24' STRIP PAVING

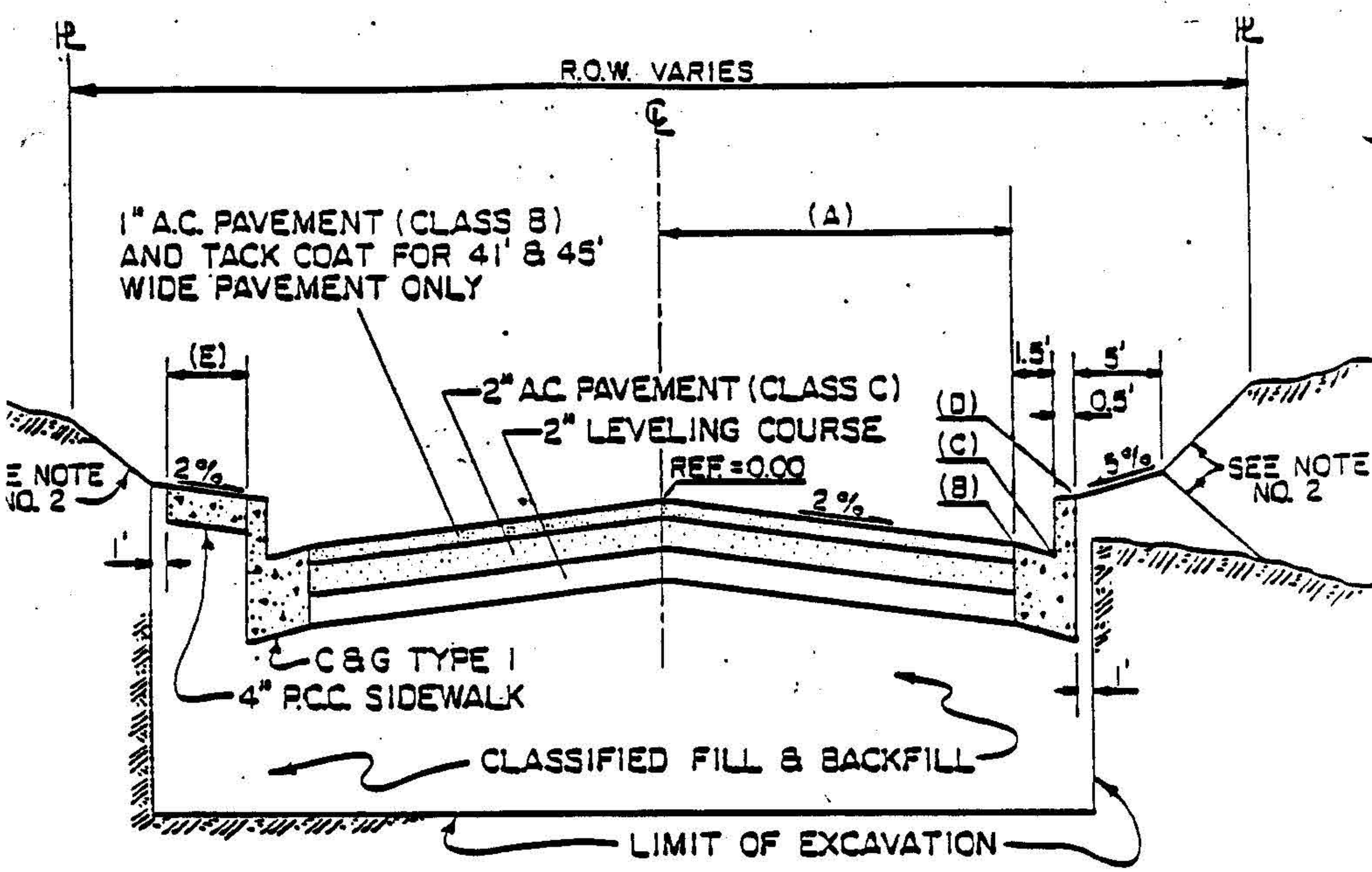


TYPICAL SECTION - 20'/24' GRAVEL STREET

NOTES:

1. MATERIAL TO BE PLACED OR REMOVED AND GRADED IN A NEAT MANNER FROM EXCAVATION LIMITS TO EXISTING ELEVATION AT PROPERTY LINE AS DIRECTED BY THE ENGINEER.
2. DEPTH OF EXCAVATION TO BE DETERMINED BY THE ENGINEER.
3. THE TOP 6" OF CLASSIFIED FILL OR BACKFILL IMMEDIATELY BENEATH THE LEVELING COURSE SHALL BE RESTRICTED TO MINUS 3-INCH MATERIAL.

FIGURE 1 - Street Section "Rural" Design



PAVEMENT WIDTH	(A) PAVEMENT	(B) LIP C&G	(C) F.L. C&G	(D) BACK C&G	(E) SIDEWALK WIDTH
36'	18'	-0.36	-0.46	0.04	4'
41'	20.5'	-0.41	-0.51	-0.01	5'
45'	22.5'	-0.45	-0.55	-0.05	5'

NOTES:

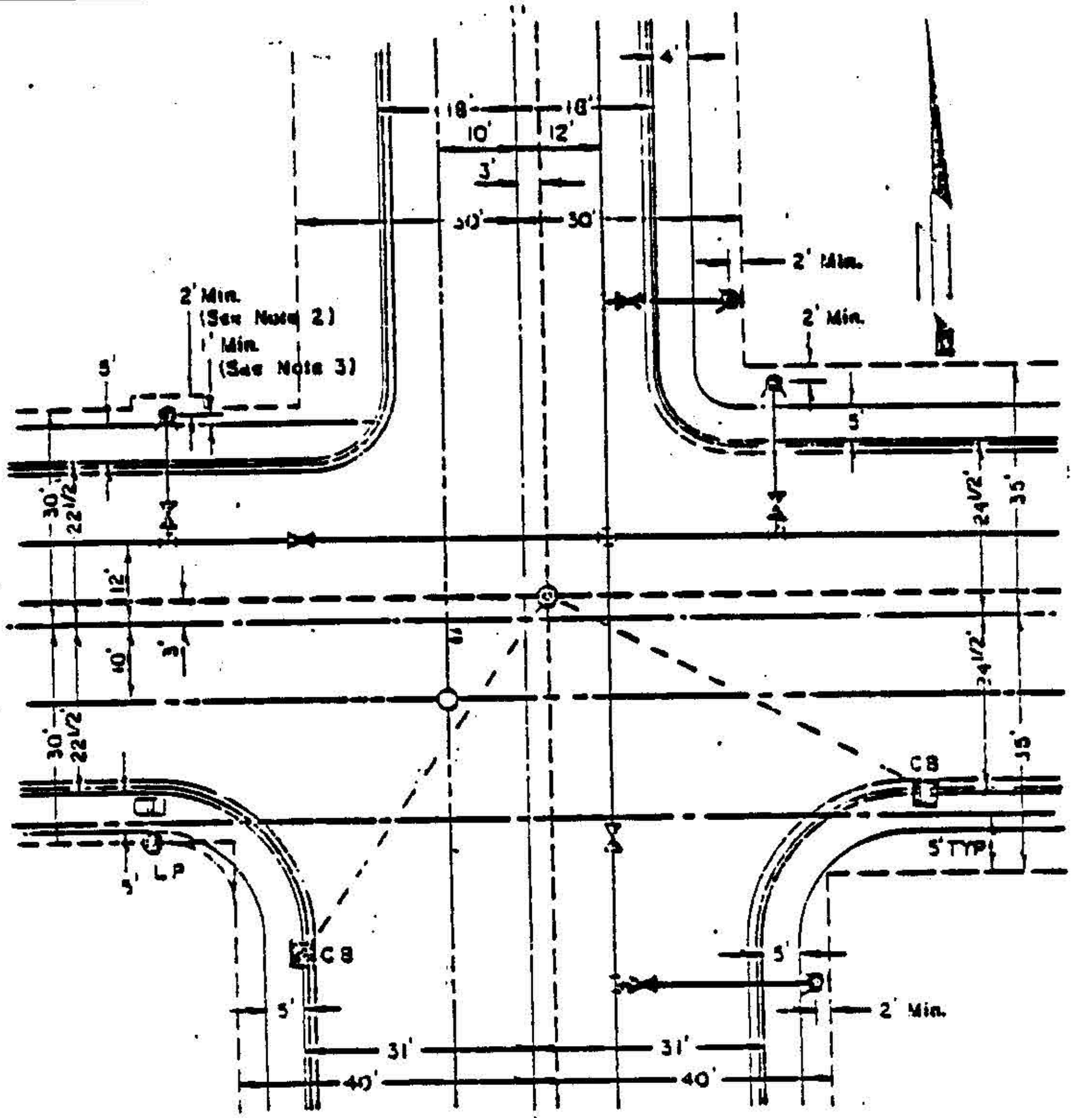
1. ALL DIMENSIONS AND ELEVATIONS AS SHOWN ON THIS DRAWING ARE TYPICAL BUT MAY VARY IN SPECIFIC INSTANCES AS SHOWN ON PLAN-PROFILE DRAWINGS OR AS DETERMINED BY THE ENGINEER.
2. MATERIAL TO BE PLACED OR REMOVED AND GRADED IN A NEAT MANNER FROM EXCAVATION LIMITS TO EXISTING ELEVATION AT PROPERTY LINE AS DIRECTED BY THE ENGINEER. (MAXIMUM - 2:1 CUT AND FILL SLOPES.
3. DEPTH OF EXCAVATION TO BE DETERMINED BY THE ENGINEER.

FIGURE 2
Street Section - "Urban" Design

FIGURE 3
Utilities in Right-of-Way

CITY OF HOMER
PUBLIC WORKS DEPARTMENT
STANDARD SPECIFICATION

STANDARD LOCATION FOR NEW UTILITYS



WATER
STORM DRAIN
SANITARY SEWER
GAS

NOTES:

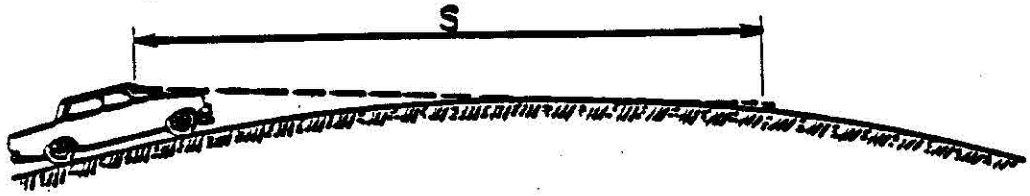
1. OFFSETS ARE TO CENTER OF UTILITY.
2. ADDITIONAL RIGHT-OF-WAY MAY BE REQUIRED TO MEET MINIMUM SET-BACKS FOR HYDRANTS
3. HYDRANT MUST BE SET-BACK A MINIMUM OF 5' FROM BACK OF CURB OR 1' FROM EDGE OF SIDEWALK.
4. CURB TO CURB DEMENSIONS SHOWN ARE TYPICAL EXAMPLES ONLY.

FIGURE 4

Stopping Sight Distance on Crest Vertical Curve

DESIGN SPEED M.P.H.	SIGHT DISTANCE FEET
30	200
40	275
50	350
60	525
65	600
70	750
75	850
80	950

HEIGHT OF EYE = 3.75 Feet
HEIGHT OF OBJECT = 0.50 Feet



L = Curve Length (Feet)
S = Sight Distance (Feet)
A = Algebraic Grade Difference (%)
V = Design Speed (M.P.H. for "S")

When S>L, $L = 2S - \frac{1398}{A}$ When S<L, $L = \frac{AS^2}{1398}$

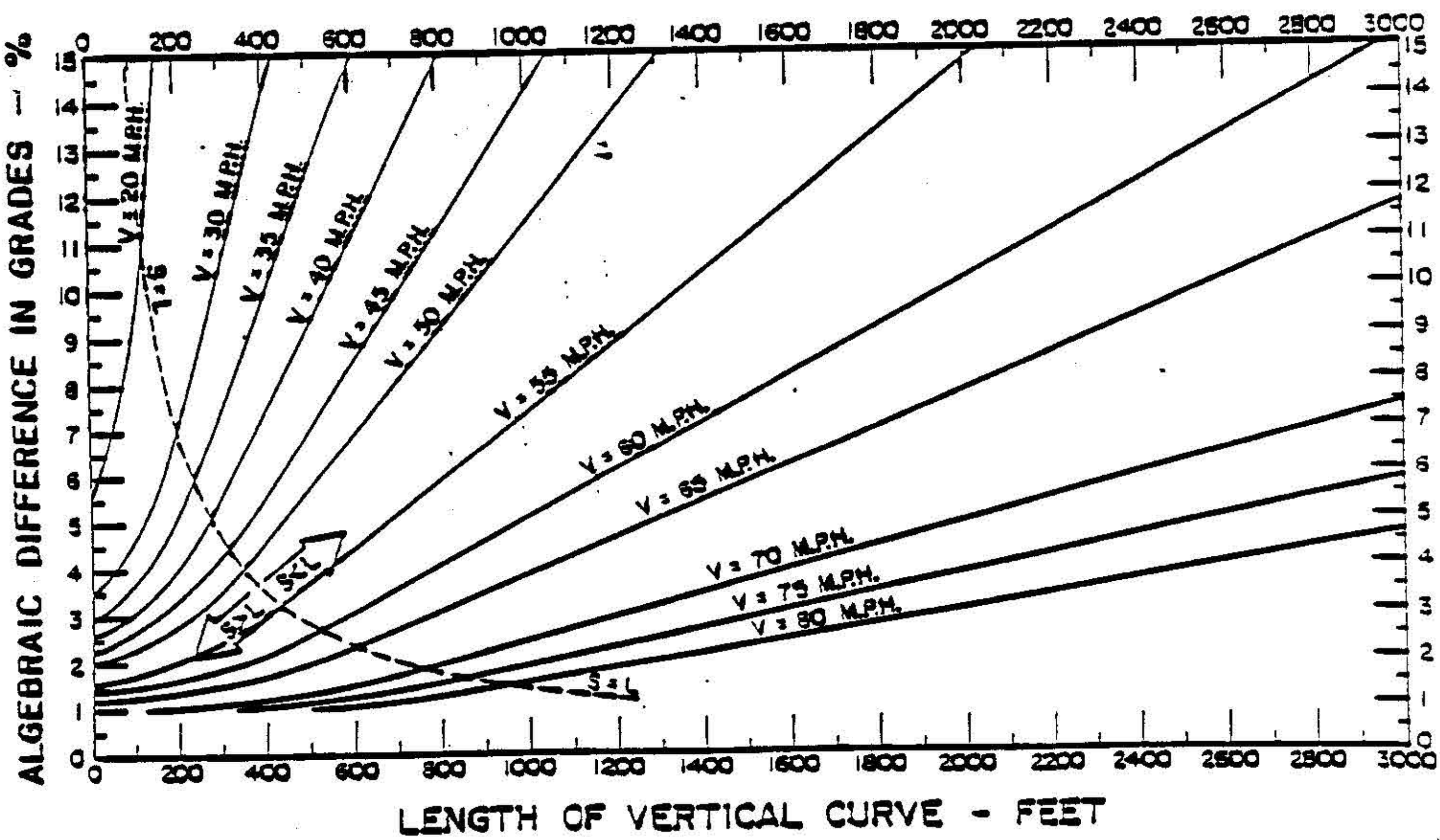
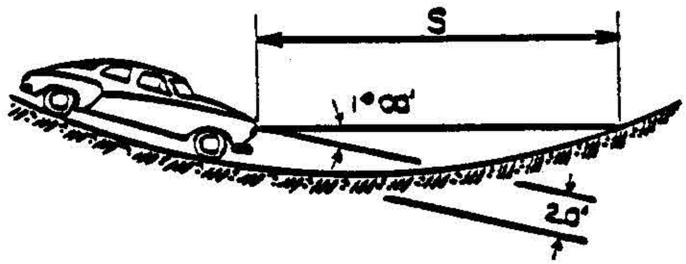


FIGURE 5

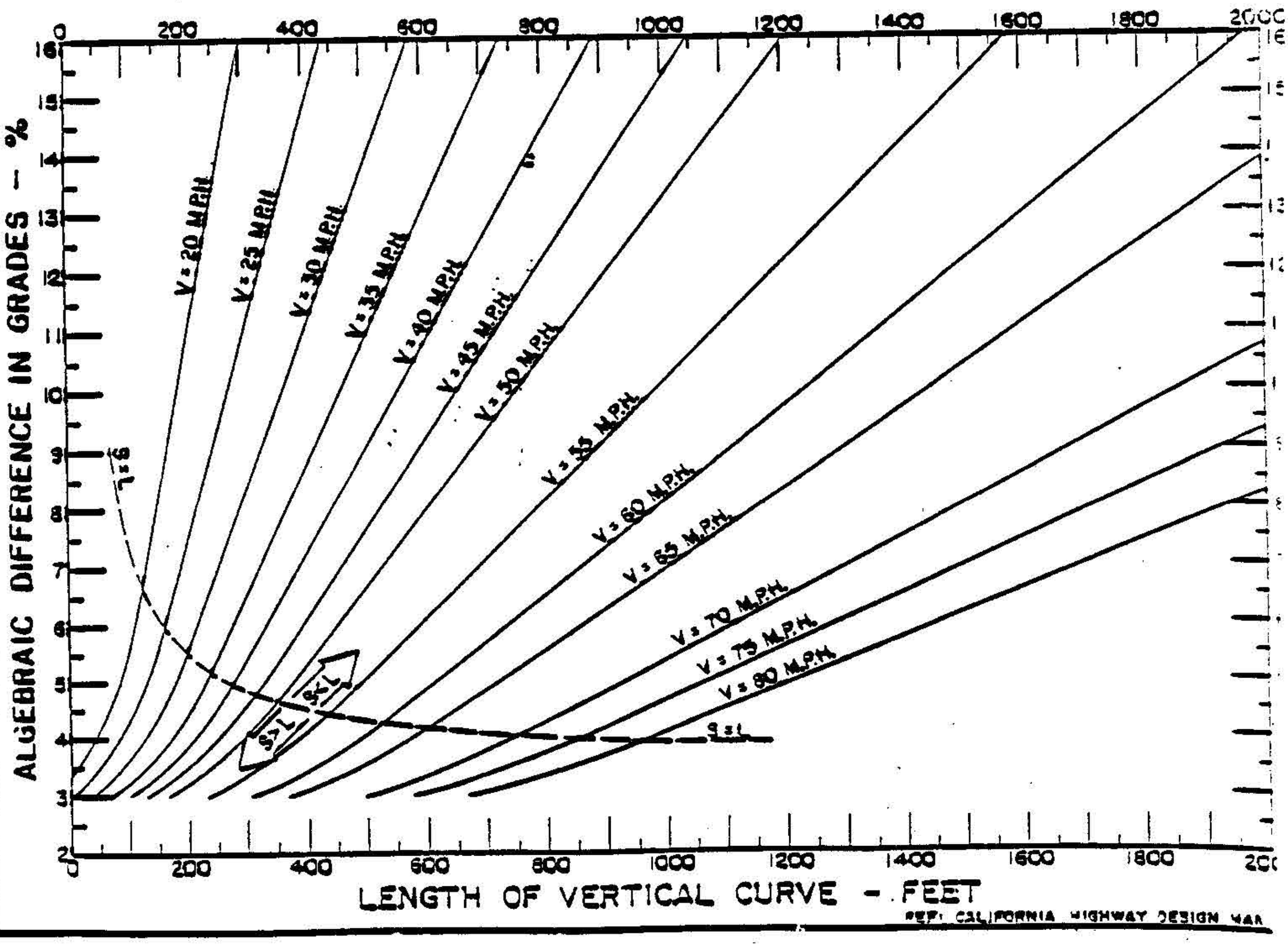
Stopping Sight Distance on Sag Vertical Curve



DESIGN SPEED M.P.H.	SIGHT DISTANCE FEET
30	200
40	275
50	350
60	525
65	600
70	750
75	850
80	950

L = Curve Length (Feet)
S = Sight Distance (Feet)
A = Algebraic Grade Difference (%)
V = Design Speed (M.P.H. for "S")

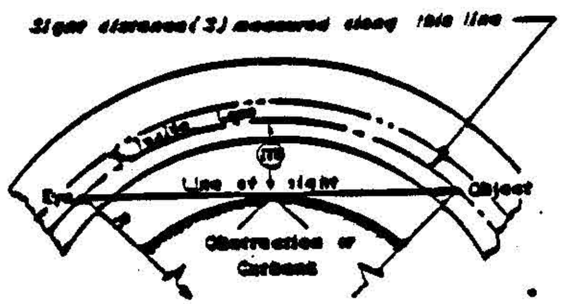
When S>L, $L = 2S - \frac{400 + 3.5S}{A}$ When S<L, $L = \frac{AS^2}{400 + 3.5S}$



REF: CALIFORNIA HIGHWAY DESIGN MAN

FIGURE 6

Stopping Sight Distance on Horizontal Curve



Height of eye=3.75 feet . . . Height of object=0.50 feet

Line of sight is 2.0 feet above ℄ inside lane at point of obstruction

DESIGN SPEED M.P.H.	SIGHT DISTANCE FEET
30	200
40	275
50	350
60	525
65	600
70	750
75	850
80	960

S = SIGHT DISTANCE IN FEET
R = RADIUS OF ℄ INSIDE LANE IN FEET
m = DISTANCE FROM ℄ INSIDE LANE IN FEET
V = DESIGN SPEED FOR S IN M.P.H.

Angle is expressed in degrees.

$$m = R\left[\text{vers}\left(\frac{28.65S}{R}\right)\right]$$

$$S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R-m}{R}\right)\right]$$

Formula applies only when S is equal to or less than length of curve.

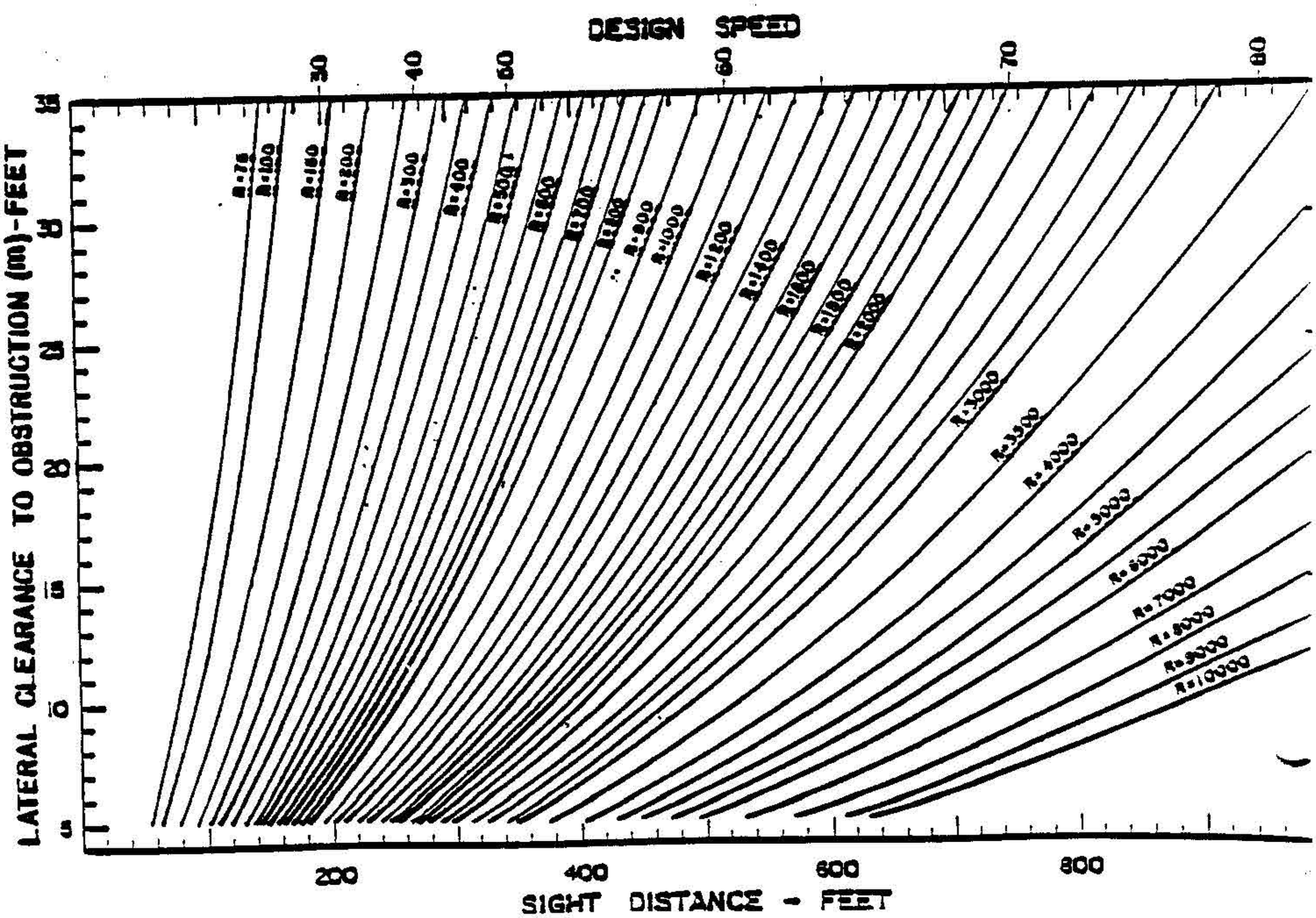
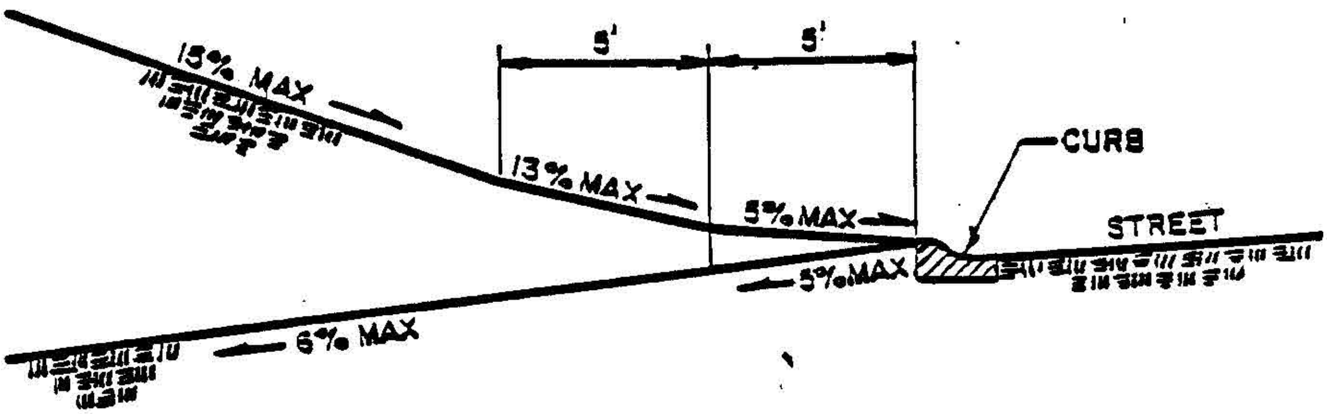


FIGURE 7

Driveway Requirements

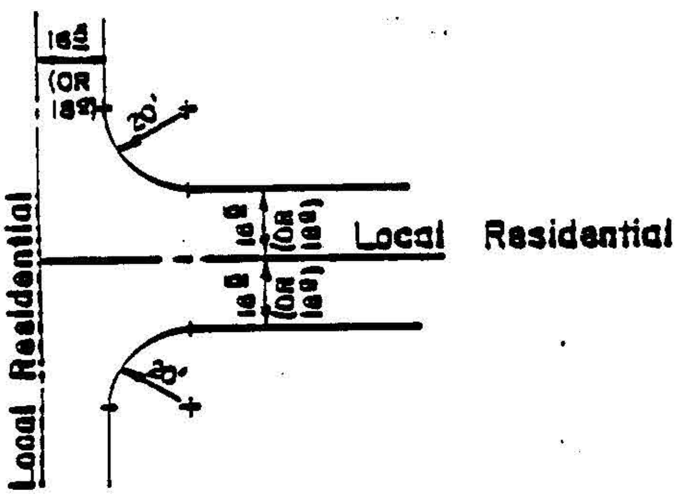
REQUIREMENTS FOR DRIVEWAYS WITHIN PUBLIC R/W

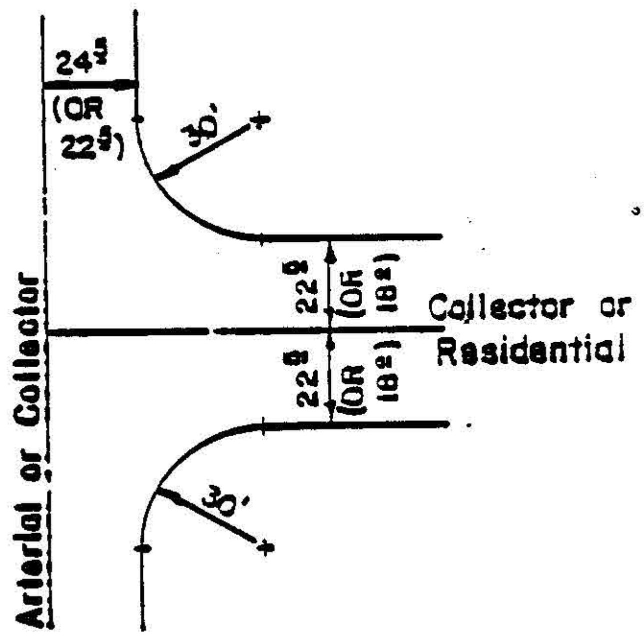


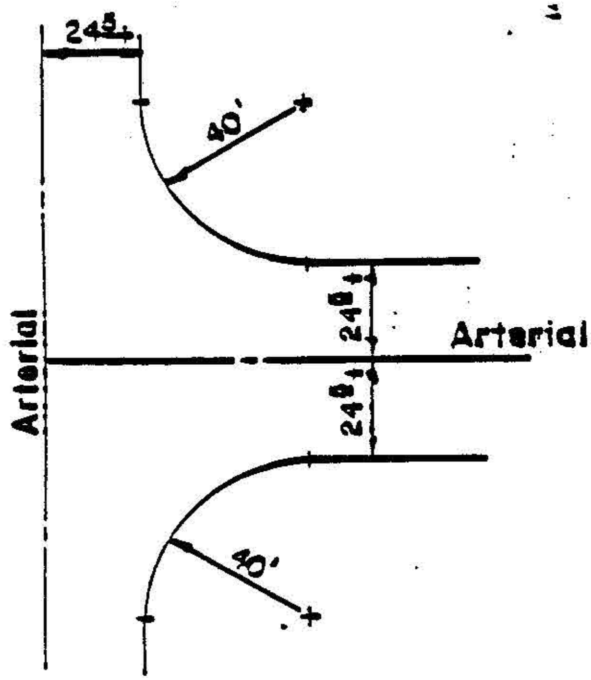
1. IN ALL AREAS WITH EXISTING CURB, THE DRIVEWAYS SHALL BE CONSTRUCTED WITH A MAXIMUM OF 5% SLOPE 5 FT. WIDE ADJACENT TO THE CURB. IN AREAS WITHOUT CURBS A 5% 5 FT. AREA SHALL BE PROVIDED FOR AND IT SHALL BE LOCATED BETWEEN 18 FT. AND 23 FT. FROM THE ℄ OF THE STREET WHERE APPLICABLE.

FIGURE 8

Curb Return Standards



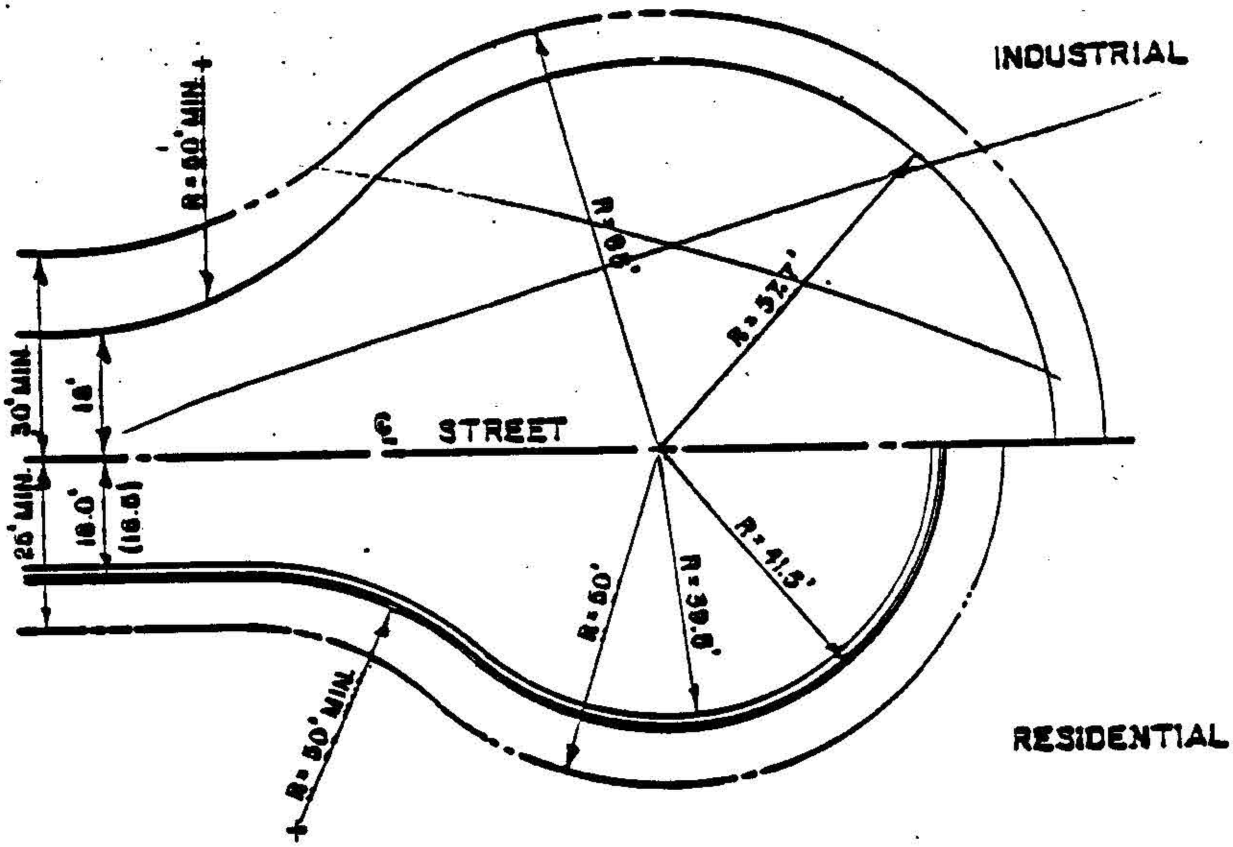


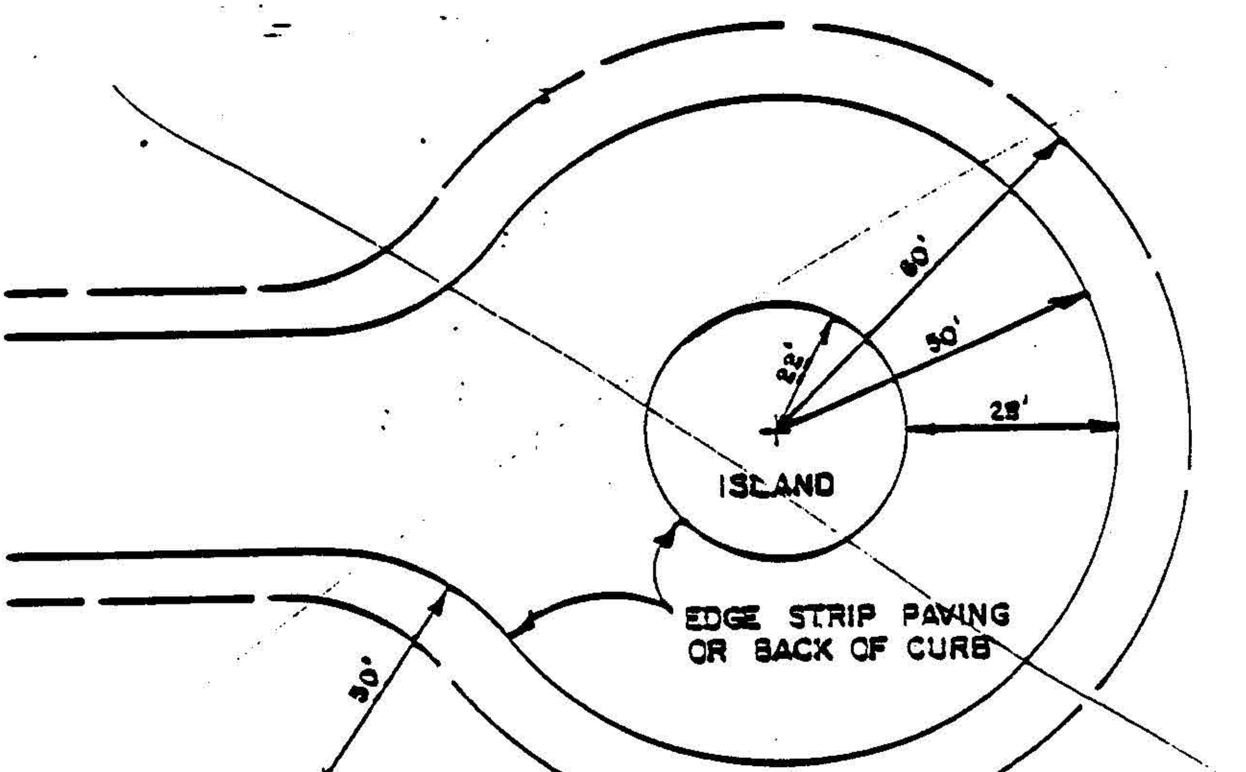


NOTE:

INCREASE RADIUS TO NEXT HIGHER CLASSIFICATION, UP TO 40' R MAXIMUM, TO ACCOMMODATE HEAVY WB-50 VEHICLES IN COMMERCIALLY OR INDUSTRIALLY ZONED AREAS.

FIGURE 9 Cul-de-sacs





ISLAND CUL-DE-SAC

FIGURE 10

REDUCED SUBGRADE STRENGTH DESIGN CURVES
FOR FLEXIBLE HIGHWAY PAVEMENTS

Ref: Corps of Engineers, TM5-818-2

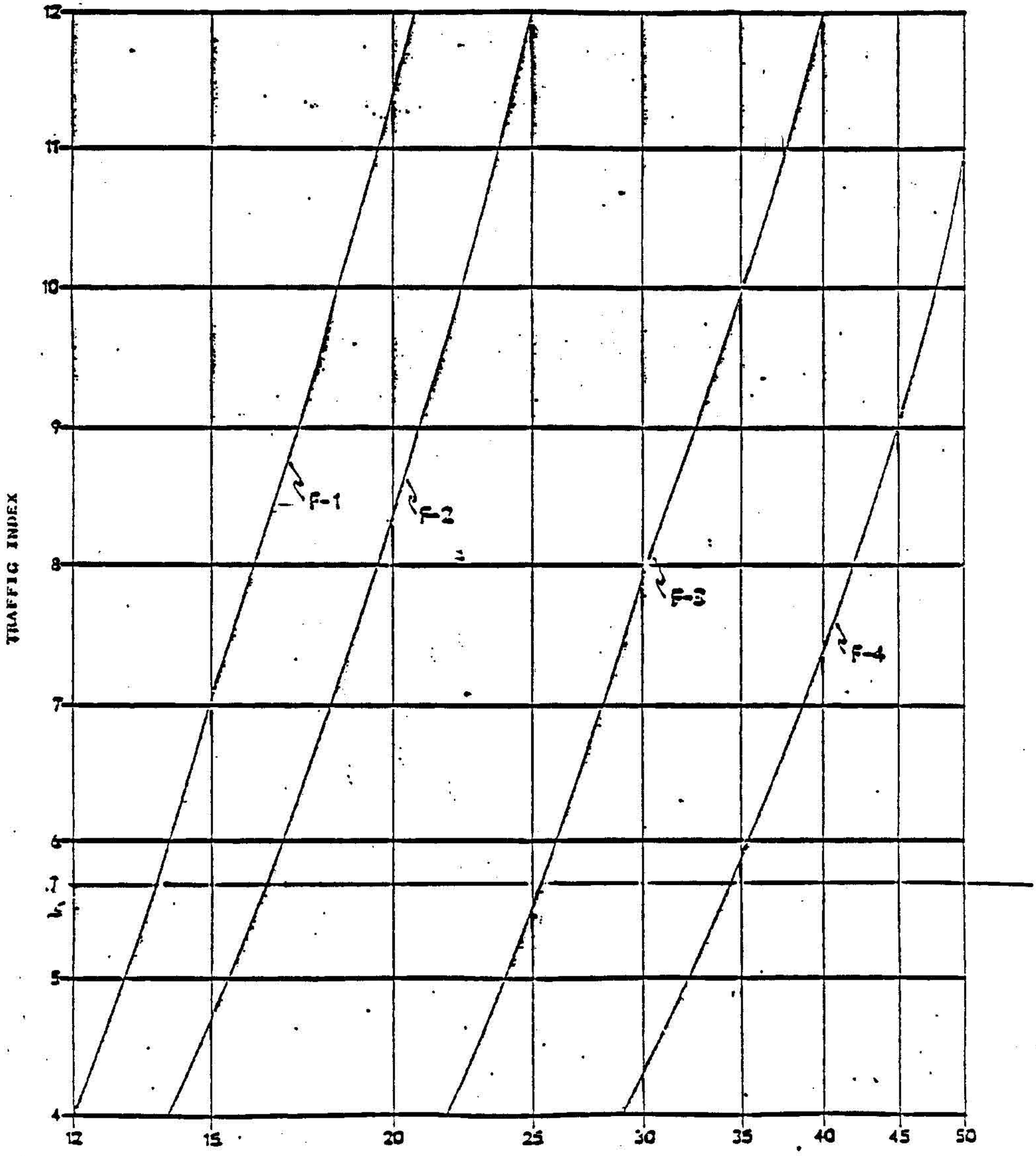
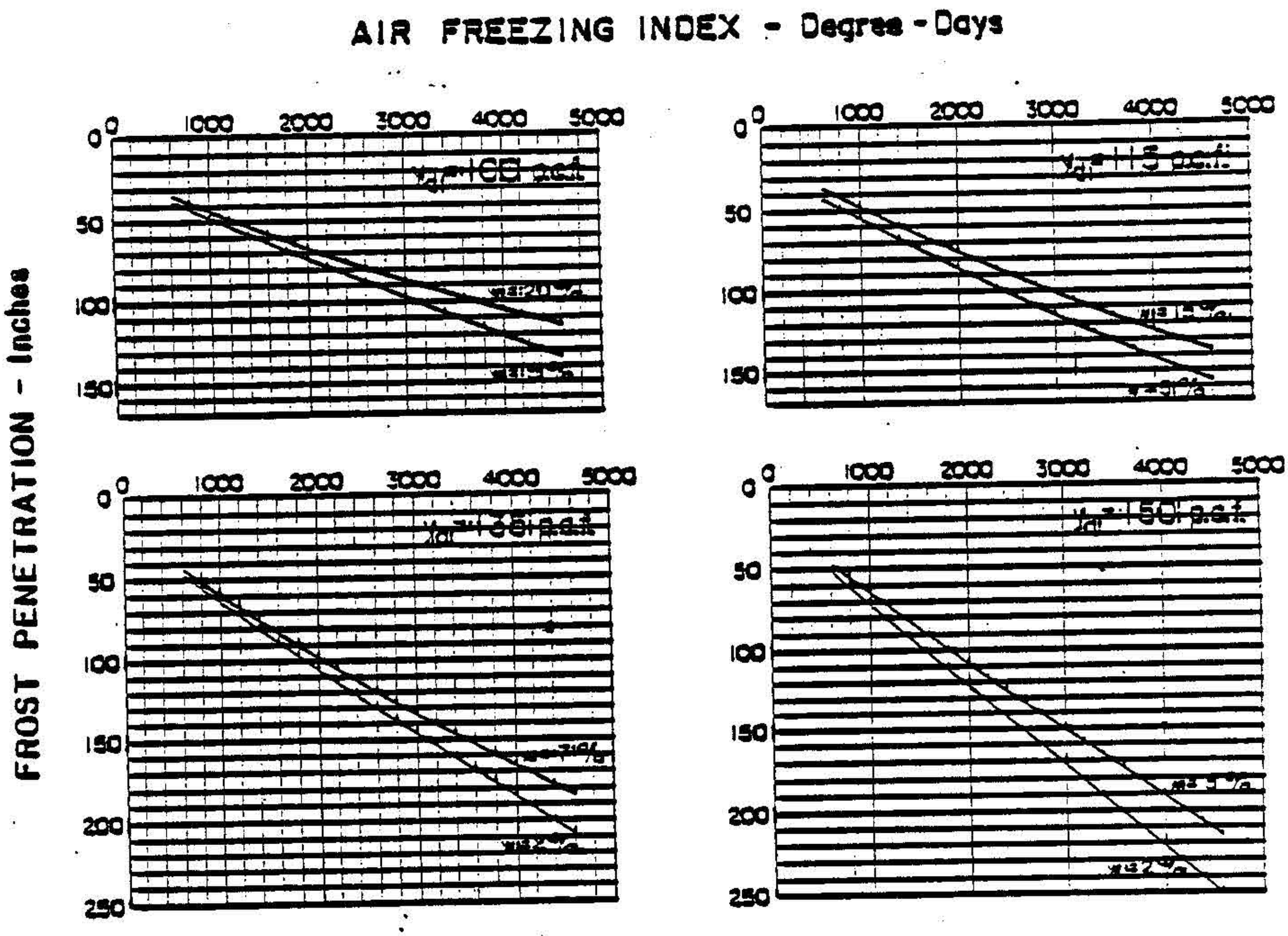


FIGURE 11

Air-Freezing Index vs. Frost Penetration

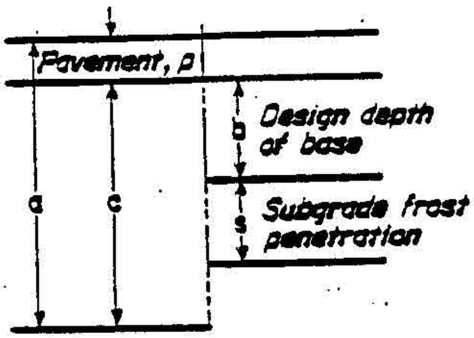


NOTE: GRAPHS ASSUME GRANULAR, NONFROST-SUSCEPTIBLE SOIL BENEATH PAVEMENTS KEPT FREE OF SNOW AND ICE.

REF: CORPS OF ENGINEERS TM 5-

FIGURE 12

Design Depth -
Limited Subgrade Frost Penetration Method



a = *Combined thickness of pavement and nonfrost - susceptible base for zero frost penetration into subgrade.*

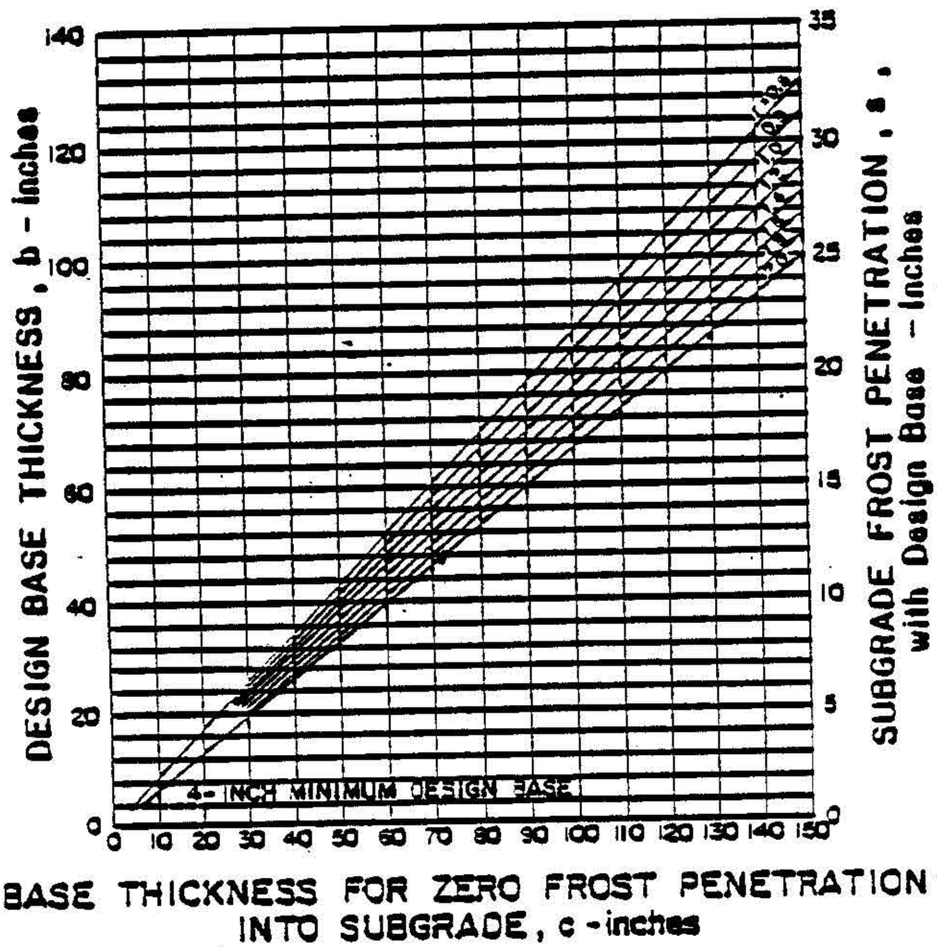
$b = a - p$

w_b = *Water content of base.*

w_s = *Water content of subgrade.*

$r = \frac{w_s}{w_b}$, *Not to exceed 2.0.*

Example: *If c = 60" and r = 2.0, then*
b = 40" and s = 10"



NOTE: DESIGN THICKNESS ASSUMES THE USE OF NFS MATERIAL FOR BACKFILL.

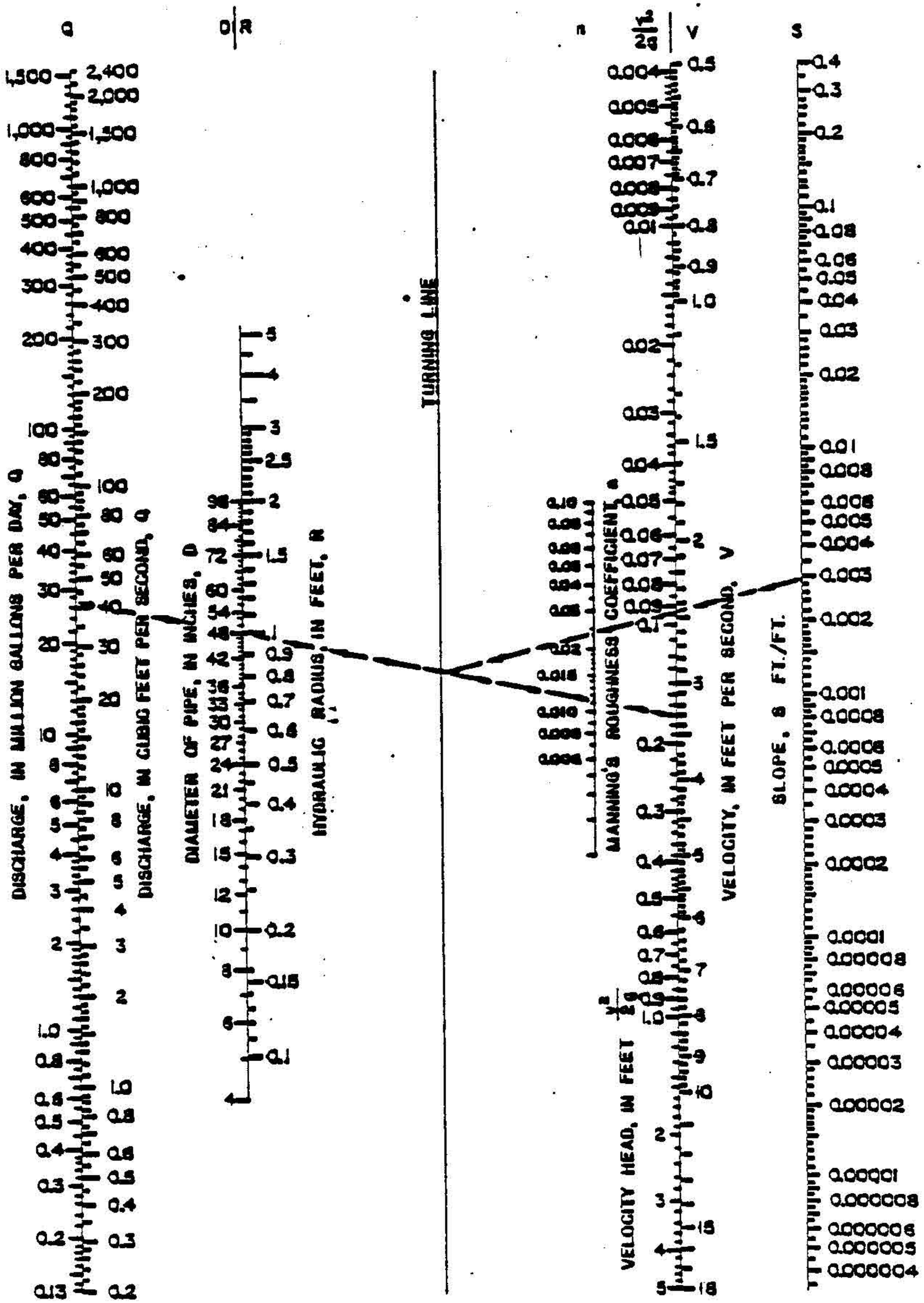
REF: CORPS OF ENGINEERS TM 5-818-

FIGURE 13
FROST DESIGN
SOIL CLASSIFICATION

ost oup	Kind of Soil	Percentage Finer than 0.02 mm by Weight	Typical Soil Types Under Unified Soil Classification System
	Gravelly soils	3 to 10	GW, GP, GW-GM, GP-GM
	a. Gravelly soils	10 to 20	GM, GW-GM, GP-GM
	b. Sands	3 to 15	SW, SP, SM, SW-SM, SP-S
	a. Gravelly soils	Over 20	GM, GC
	b. Sands, except very fine silty sands	Over 15	SM, SC
	c. Clays, PI 12	—	CL, CH
	a. All silts	—	ML, MH
	b. Very fine silty sands	Over 15	SM
	c. Clays, PI 12	—	CL, CL-ML
	d. Varved clays and other fine-grained, banded sediments	—	CL and ML; CL, ML, and SM; CL, CH, and ML; CL, CH, ML, and SM

FIGURE 14

Manning Equation Nomograph



REF: PUBLIC WORKS MAGAZINE, 1948

FIGURE 15

Source: Water Quality Management Plan, Municipality of Anchorage

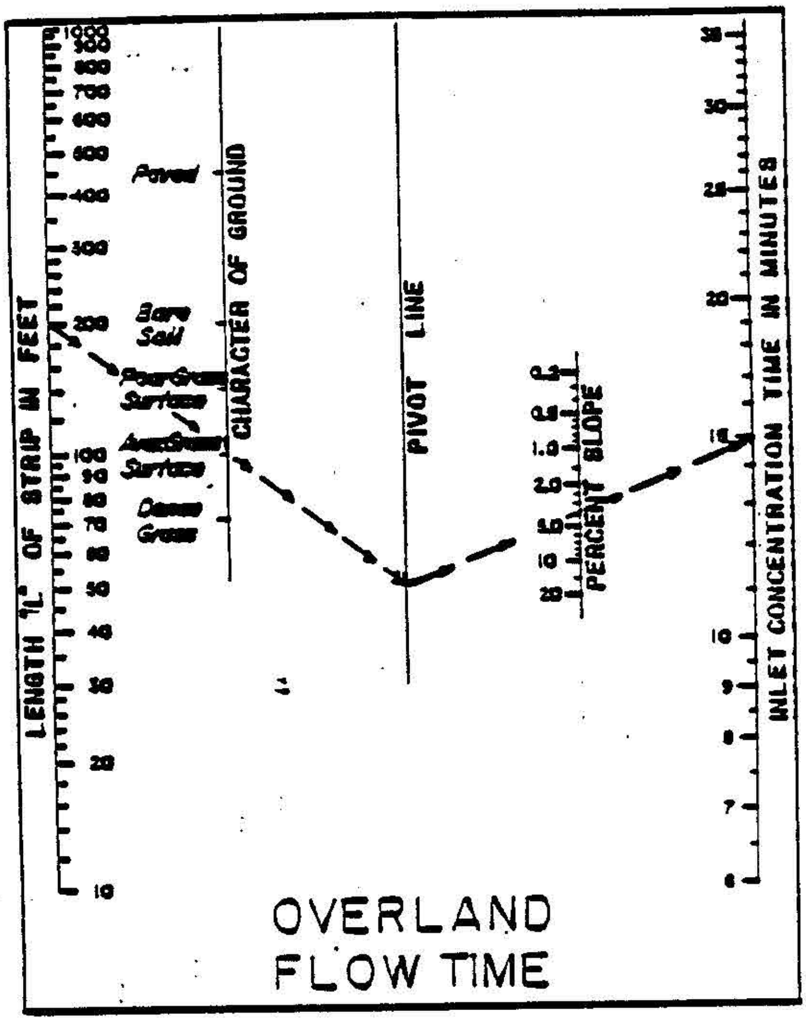
ESTIMATING VALUES FOR IMPERVIOUS AREAS CONTRIBUTING TO STORM DRAIN FLOW

AND USE CATEGORY	IMPERVIOUS PERCENT AREA		
	Directly Connected	Indirectly Connected	Total
Parks & Open Space	0	0	0
Public Lands & Institutions	35	10	45
Commercial	70	20	90
Commercial/Industrial	70	10	80
Industrial	50	20	70
Residential (by dwelling units per acre)			
less than 3	5	15	20
3 to 6	17	12	30
7 to 10	25	10	35
11 to 20	30	10	40
21 to 30	35	10	45
greater than 30	40	15	55

Note: These percentages are based on the recommendations of the 208 Water Quality Management Plan and assume that roof drains are not normally connected directly to the storm drain. In most instances the Land Use Category is that shown in the Anchorage Bowl Comprehensive Development Plan.

FIGURE 16

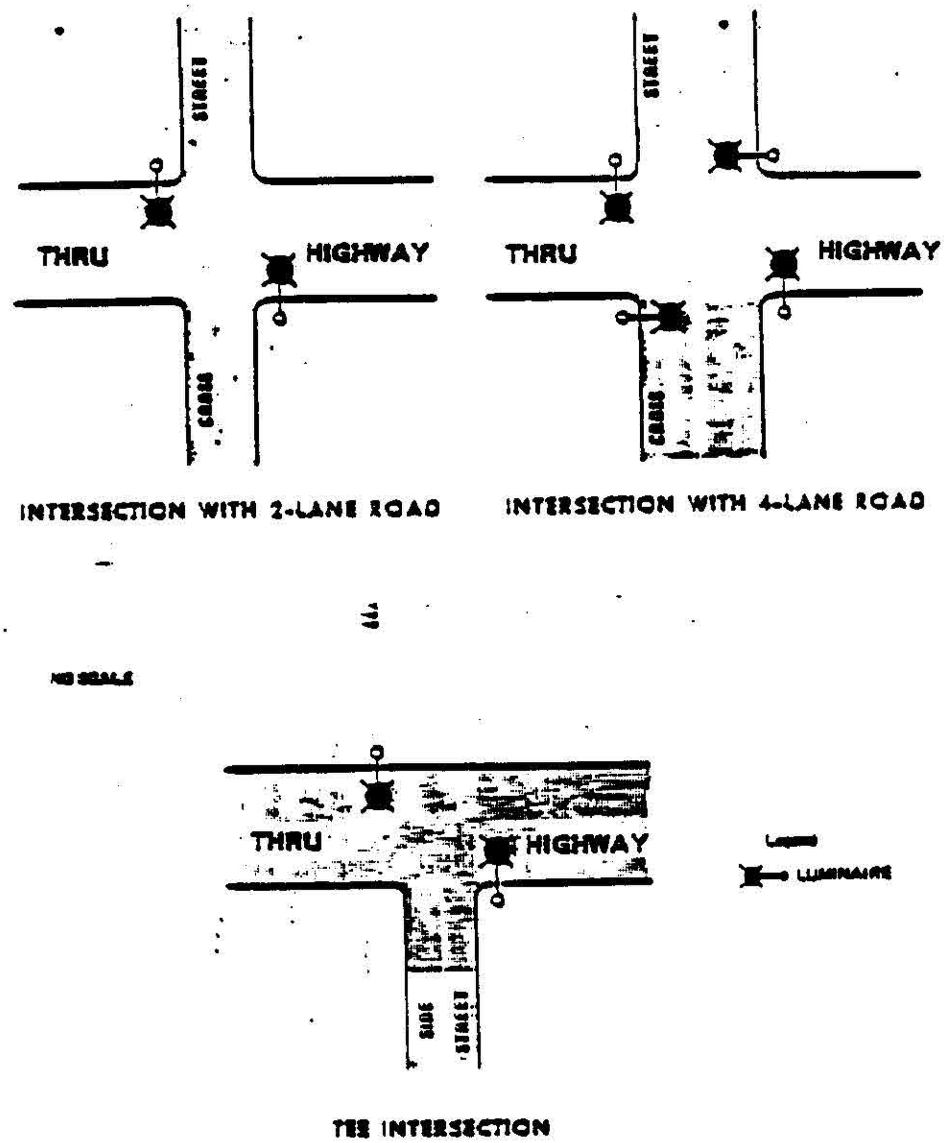
Overland Flow Time



REF: SEELYE 18-01, FOURTH PRINTING, OCT. 1966

FIGURE 17

Typical Lighting at Non-Channelized Intersections



TYPICAL LIGHTING AT NON-CHANNELIZED INTERSECTIONS

SECTION 1.09

APPENDICES

APPENDIX I

TABLE 10-22
Vehicle Trip Generation of Urban Land Use

Trip Generator†	Daily Trips In + Out: Min.	Avg.	Max.	A.M. Peak Hour Trips: In	Out	P.M. Peak Hour Trips: In	Out	Peak Hour of Trip Generation: In	Out	Time of Day
Shopping center/1000 gross ft^2										
0–49,999 ft^2	21.5	115.8	270.9	1.1	0.9	7.2	7.2	7.6	7.8	P.M.
50,000–99,000 ft^2	25.5	79.1	161.3	2.9		2.4	2.7	9.1		P.M.
100,000–199,000 ft^2	32.1	60.4	103.7	—		2.6	2.9	3.0	2.8	P.M.
200,000–299,000 ft^2	18.0	49.9	92.0			2.1	2.3	2.7	2.5	P.M.
300,000–399,000 ft^2	16.0	40.4	58.4	—		5.2		5.2		P.M.
400,000–499,000 ft^2	29.0	47.6	90.0	—		5.7		5.0		P.M.
500,000–999,000 ft^2	17.3	34.5	61.2	0.6	0.3	1.2	1.3	2.2	1.9	P.M.
1,000,000–1,249,000 ft^2	16.4	31.1	57.0			1.4	1.8	0.7	4.2	P.M.
1,250,000 ft^2 and over	18.9	26.5	35.7	0.4	0.2	1.1	1.5	1.4	1.7	P.M.
Discount store										
7000–150,000 ft^2	29.8	64.6	121.1	1.4	1.9	2.6	2.4			
Hardware or paint store										
1000 gross ft^2	43.6	51.3	74.1	1.1		4.9		5.2		P.M.
Employee	45.9	53.2	58.2	5.1		5.1		5.4		P.M.
Employee (Sat.)	62.8	85.6	94.1							
Acre	467.0	546.0	906.0	11.6		51.8		55.6		P.M.
Supermarket										
1000 gross ft^2	51.7	125.5	270.8			3.7	3.3	6.0	7.4	P.M.
Convenience market—24-hour										
1000 gross ft^2	480.0	577.5	699.2							
Restaurant—quality										
Seat		1.2		0.0	0.0	0.1	0.1	0.2	0.2	P.M.
1000 gross ft^2		56.3		0.8	0.5	2.8	1.7	5.1	4.4	P.M.
Restaurant-sitdown										
1000 gross ft^2	47.9	164.4	551.2	—		9.9	4.0	13.0	9.2	P.M.
Restaurant-drive-in										
1000 gross ft^2	37.6	55.3	82.8			17.0	14.6	44.4	41.9	Noon
New-car sales										
Site				33.0	19.5	19.0	40.5			
Service station										
Station	620.0	748.0	100.0	21.0		25.0		31.0		P.M.
Pump	103.0	133.0	170.0							
Car wash										
Site								59.6		Sat.
Highway oasis										
Site				34.0	43.0	27.0	55.5	40.0	64.5	P.M.
Truck stop										
Site				31.5	32.5	39.0	48.5	50.5	52.5	P.M.
Banks—walk-in										
1000 gross ft^2		169.0		4.4		35.8		35.8		P.M.
Employee		44.5		1.2		9.4		8.7		P.M.
Banks—drive-in										
1000 gross ft^2	160.0	192.0	270.0	5.4		6.5	12.3	18.3	12.8	P.M.
Employee	32.0	117.4	92.0	1.2		2.3	4.4	6.5	4.5	P.M.
Window	207.0	297.0	330.0	5.0		20.0	26.0	44.0		P.M.
Savings and loan—walk-in										
1000 gross ft^2		61.0		1.3		5.3		9.		A.M.
Employee		30.5		0.7		2.7		4.8		P.M.
Savings and loan—drive-in										
1000 gross ft^2		74.0		1.0		6.8		9.7		P.M.
Employee		49.0		0.7		4.6		6.4		P.M.
Window		445.0		6.0		41.0		58.0		P.M.
Insurance										
1000 gross ft^2	10.1	11.5	12.5	2.3		2.4		2.4		P.M.
Employee	2.4	2.4	2.5	0.5		0.5		0.5		P.M.
Acre		91.8		18.3		17.9		18.3		A.M.
General office building										
Employee	2.4	3.6	11.2	0.6		0.6		0.6		P.M.
1000 gross ft^2	3.6	12.3	43.5	1.9	0.4	0.3	1.9	1.9	0.4	A.M.
Acre	51.0	240.1	299.7	19.2		18.0				
dical office										
000 gross ft^2	38.0	75.0	99.0						6.4	P.M.
rnment office										
mployee		12.0		0.8	0.2			1.4	0.5	P.M.
1000 gross ft^2		68.9		4.9	1.0			8.2	2.8	P.M.

Reprinted from "Traffic and Transportation Engineering Handbook" (ITE, 1982)

TABLE 10-22 (Continued)
Vehicle Trip Generation of Urban Land Use

Trip Generator	Daily Trips In + Out			A.M. Peak Hour Trips		P.M. Peak Hour Trips		Peak Hour of Trip Generation		
	Min.	Avg.	Max.	In	Out	In	Out	In	Out	Time of Day
Civic center										
Employee		6.1		0.5	0.1	0.2	0.5			
1000 gross ft²		25.0		2.0	0.2	0.9	2.0			
Office park										
Employee	2.9	3.3	3.5	0.6		0.5		0.6		A.M.
1000 gross ft²	9.4	20.6	30.3	9.4	0.3	0.3	1.8	2.0	0.3	A.M.
Acre		276.6		52.7		44.7		52.7		A.M.
Research center										
Employee	2.0	3.1	5.3	0.5		0.5		0.7		P.M.
1000 gross ft²	4.3	9.3	9.8	1.3		1.5		1.6		P.M.
Acre		37.7		7.3		8.4		8.4		P.M.
Commercial airport										
Employee	11.6	16.8	26.6	1.0	0.7	1.4	1.5	0.5	0.6	A.M.
Flights/day	2.6	11.8	60.7	0.2	0.1	0.2	0.2	1.9	2.1	P.M.
Commercial flights/day		77.9	84.6	3.0	2.0	4.2	4.4	2.7	2.9	P.M.
General aviation airport										
Employee		6.5	122.0	—	—	—	—	0.2	0.3	P.M.
Flights/day	1.0	3.1	10.3	0.2	0.2			0.2	0.4	P.M.
Truck terminals										
Employee	4.2	47.3	7.0	0.3	0.4	0.3	0.3	0.3	0.4	A.M.
1000 gross ft²		9.9		0.4	0.5	0.4	0.5	0.4	0.5	
Acre	66.2	81.9	100.1	3.1	4.6	3.0	3.4	3.1	4.6	
Industrial—general										
Employee	1.4	3.0	15.7	0.5		0.6		0.6		A.M.
1000 gross ft²	0.5	5.4	52.0	0.8		1.0		1.0		A.M.
Acre	3.5	59.9	441.2	9.3		12.0		11.5		A.M.
General light industrial										
Employee	1.5	3.2	4.5	0.7	0.1	0.3	0.5	0.3	0.5	P.M.
1000 gross ft²	1.6	5.5	16.9	0.8	0.2	0.3	0.6	0.3	0.7	
Acre	5.2	52.4	159.4	18.2	3.3	6.9	13.6	6.9	13.3	
General heavy industrial										
Employee	0.7	0.8	1.8	0.4		0.6		0.3		A.M.
1000 gross ft²	0.4	1.5	1.8	0.5		0.2		0.7		A.M.
Industrial park										
Employee	1.4	3.9	8.8	0.5	0.2	0.6		0.2	0.5	P.M.
1000 gross ft²	0.9	7.3	37.0	1.0		1.2			0.9	P.M.
Acre	13.9	56.1	441.2	7.9	2.8	10.0			8.0	P.M.
Manufacturing										
Employee	0.6	2.0	6.7	0.4		0.2	0.2	0.4		A.M.
1000 gross ft²	0.5	4.0	52.0	0.8		0.8		0.8		A.M.
Acre	2.5	38.3	396.0	7.3		8.4		9.0		A.M.
Warehousing										
Employee	3.0	4.3	15.7	0.5		1.4		1.4		A.M.
1000 gross ft²	1.5	5.0	17.0	0.6		1.6		1.6		P.M.
Acre	42.5	62.0	256.0	9.8		20.2		20.0		A.M.
Military base										
Employee	1.0	1.8	4.1							
Vehicle	0.6	0.9	2.3							
Elementary school										
Employee	4.5	13.1	26.4	2.9		0.3		3.4		A.M.
Student	0.5	1.0	1.8	0.2		0.0		0.3		
High school										
Student	0.7	1.4	2.5	0.3		0.2		0.3		A.M.
Employee	4.0	455.0	937.0					3.5		
Junior/community college										
Student	0.9	1.6	2.9	0.2	0.0	0.0	0.1	0.2	0.0	A.M.
University										
Student	1.4	2.4	3.9							P.M.
Library										
Employee	36.8	51.0	81.9					3.8	3.4	P.M.
1000 gross ft²		41.8						3.0	2.7	P.M.
Hospital										
Employee	2.2	5.5	11.1					0.3	0.4	P.M.
Bed	3.0	12.2	32.8					0.5	0.9	P.M.
1000 gross ft²		16.9						2.3		
Nursing home										
Bed	1.9	2.7	4.0		0.1		0.2	0.4		P.M.
Clinic (research and special cases)										
Employee		5.9							0.6	P.M.

CITY OF HOMER

Wayne L. Kessler, Mayor

ATTEST:

Narda Koby, Acting City Clerk

Reviewed and approved as to form and content:

Phil C. Shealy, City Manager

Date: 5/28/85

A. Robert Hahn, City Attorney

Date: 5-28-85

First Reading: 05/28/85

Public Hearing: 06/10/85

Second Reading: 06/24/85

Date of Adoption: 07/01/85

Effective Date: 09/01/85