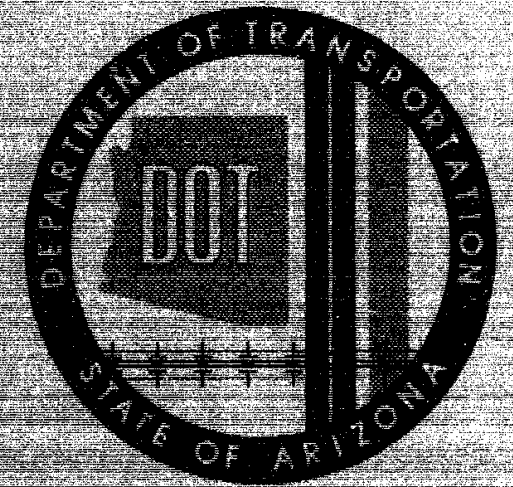




**STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
PLANS SERVICES**



**ROADWAY GUIDES
FOR USE IN
OFFICE AND FIELD

1982**

ROADWAY GUIDES

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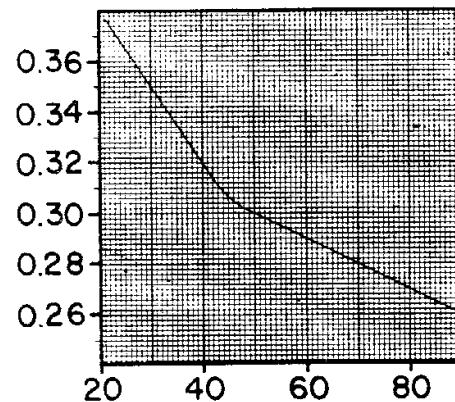
ROADWAY GUIDES

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f = Wet Coefficient Of Friction Between
Tires And Roadway
From - "A Policy On Design Standards
For Stopping Sight Distance" By
AASHTO, Dated 1971



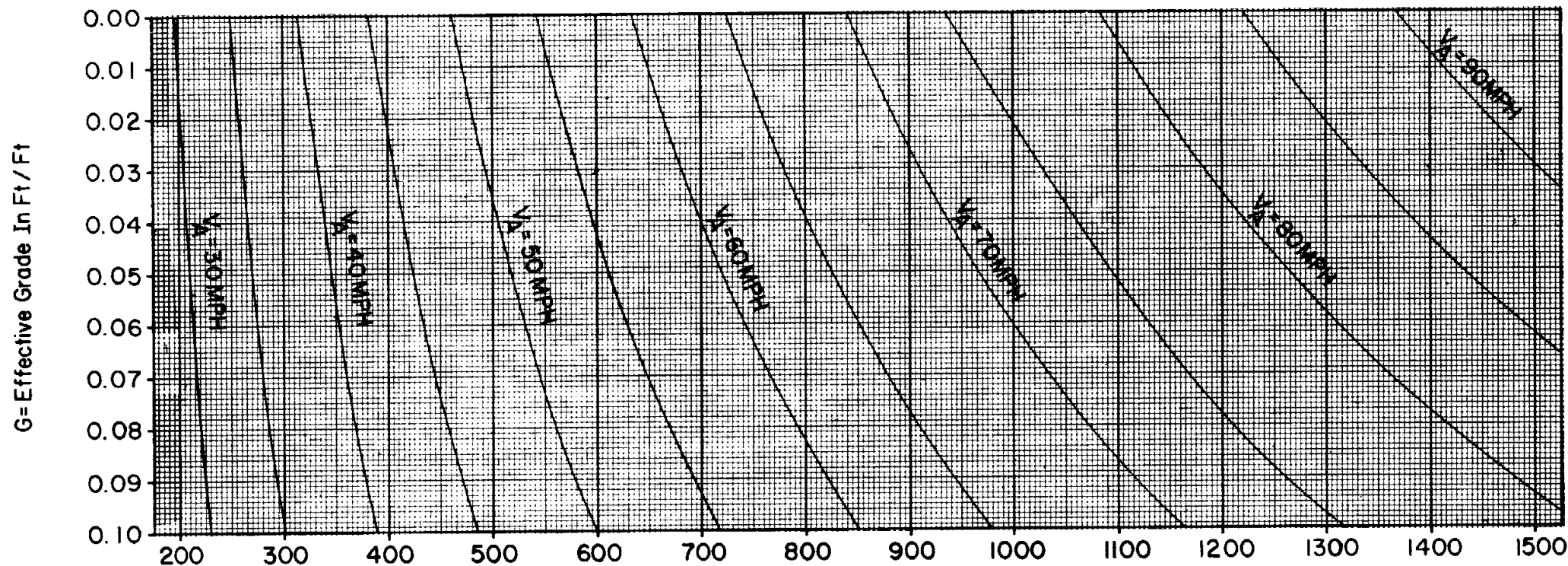
V_A = Assumed Speed For Wet Conditions In MPH

NOTE: The Sight Distance, Stopping, Graph is for roads with two way traffic or applicable for roads with one way traffic going down grade.

For roads with one way traffic upgrade, other special cases, and an explanation of the graph, see "Manual of Highway Geometric Design," ADOT, Sections 7-03, 7-09, and 7-10.

Between vertical curves the effective grade is the grade of the roadway.

In Vertical Curves, the largest grade, ignoring the + or -, is the effective grade.



SDs = Sight Distance, Stopping, (Min) In Ft

SIGHT DISTANCE, STOPPING:

$$SDs = 1.467 V_A (2.5) + \frac{V_A^2}{30(f \pm G)}$$

SDs = Sight Distance, Stopping (Min) In Ft

V_A = Assumed Speed For Wet Conditions
In MPH.

f = Wet Coefficient Of Friction Be-
tween Tires And Roadway.

G = Grade Of Road In Decimal Form
(Ft/Ft)

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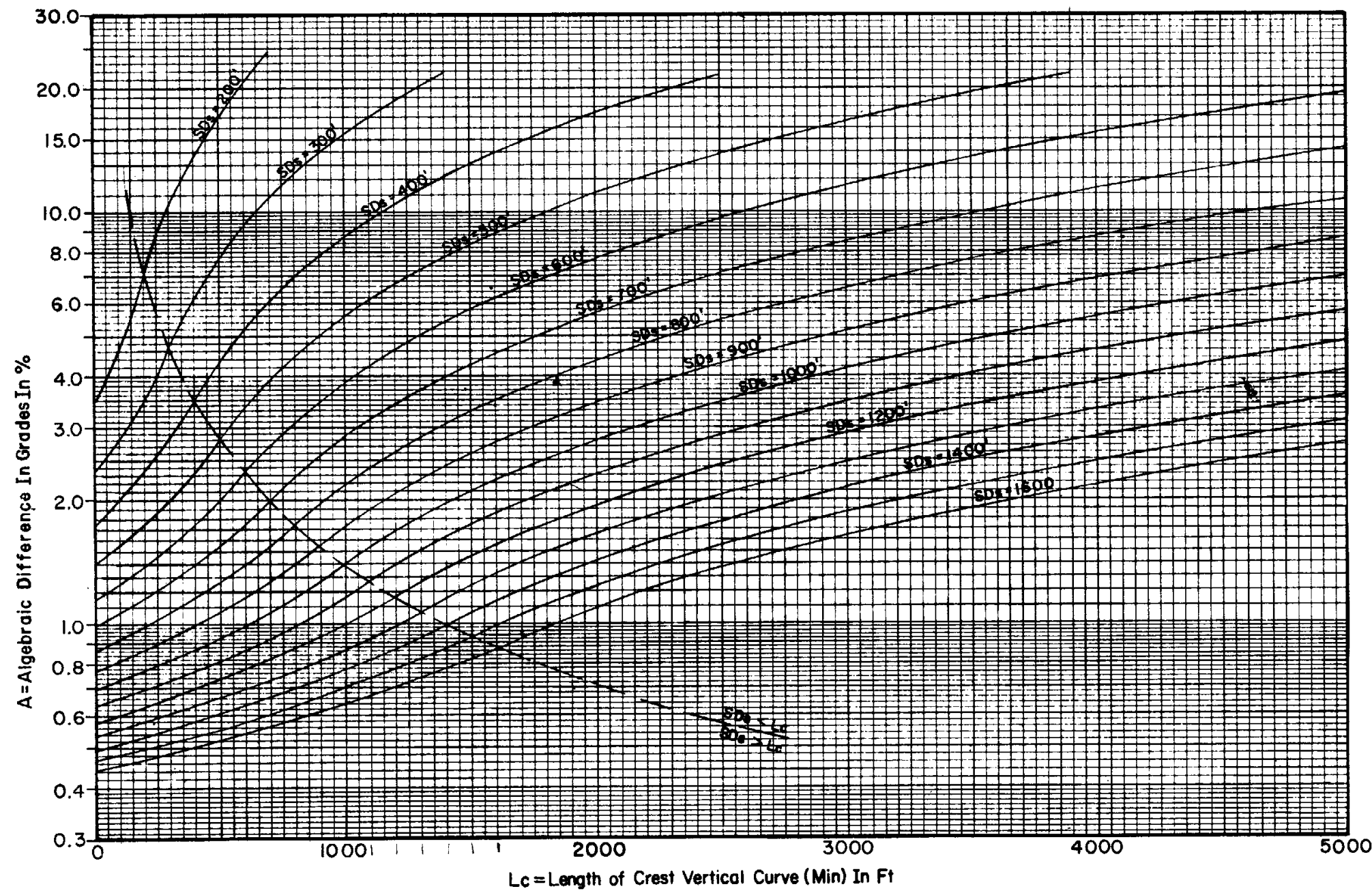
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SIGHT DISTANCE, STOPPING

PLAN NO.

D-51.10


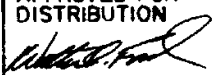


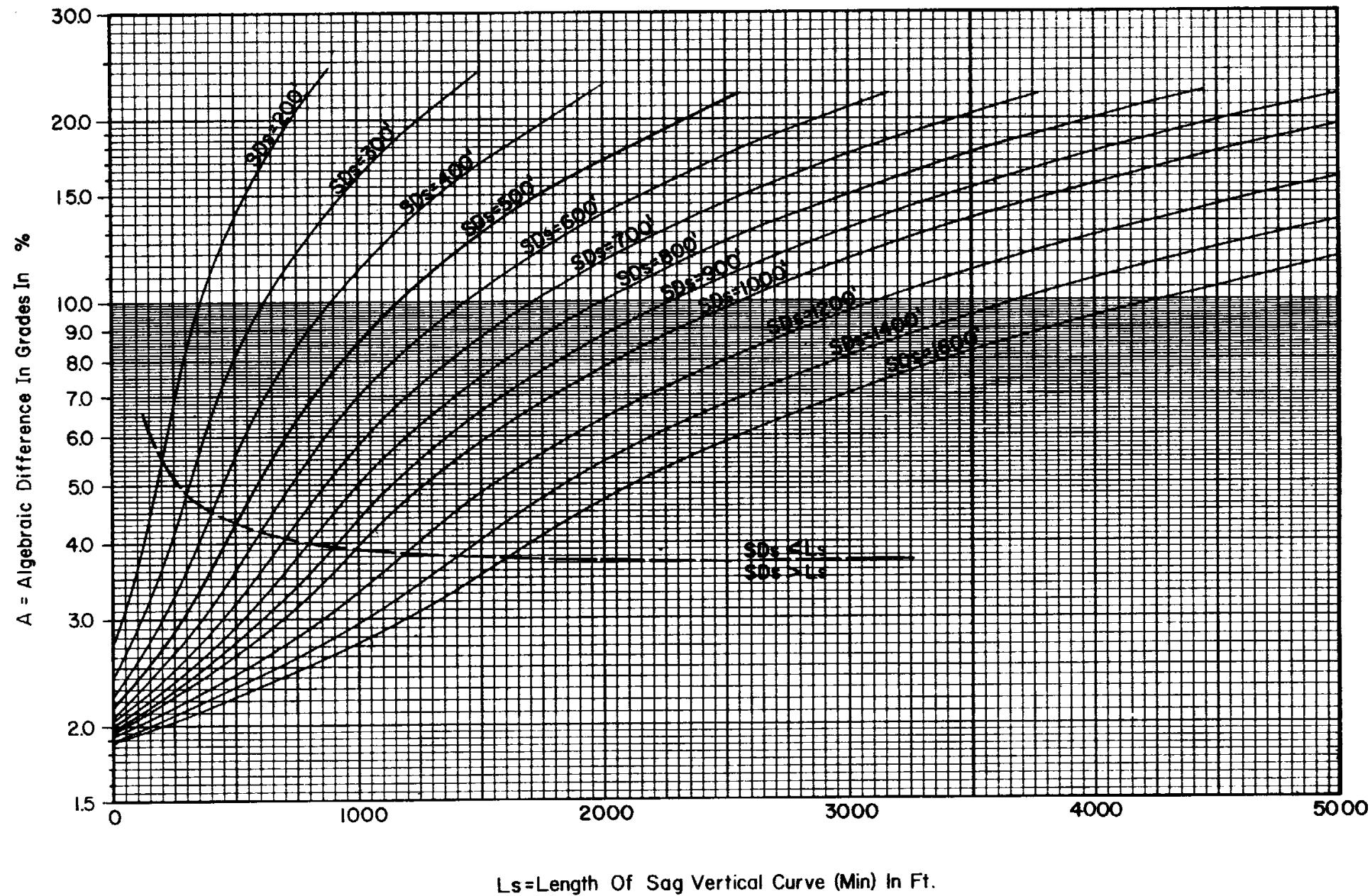
NOTE: See D-51.10 for Sight Distance, Stopping, (SDs)

Minimum Length of Vertical Curves:
1,000 ft. for Interstate Highways.
800 ft. for Primary and Secondary Hwys.
3 Times Design Speed in MPH for all other roadways.

See "Manual of Highway Geometric Design," ADOT, Section 7-04 for general explanation and Section 10-02.3 for minimum length of vertical curves on ramps.

LENGTH OF CREST VERTICAL CURVES:
If SDs < Lc Then $Lc = \frac{A(SDs)^2}{1398}$
If SDs > Lc Then $Lc = 2(SDs) - \frac{1398}{A}$
Lc=Length Of Crest Vertical Curve In Ft (Min)
SDs=Sight Distance, Stopping, In Feet
A= Algebraic Difference In Grade In Percent Form

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APPROVED FOR DISTRIBUTION 	LENGTH STANDARDS CREST VERTICAL CURVES		PLAN NO. D-51.20



NOTE: See D-51.10 for Sight Distance, Stopping (SDs)

Minimum Length of Vertical Curves:

- 1,000ft. for Interstate Highways.
- 800ft. for Primary and Secondary Hwys.
- 3 Times Design Speed in MPH for all other roadways.

Check SDs against light beam distance.
See "Manual of Highway Geometric Design," ADOT, Section 7-05 for general explanation and Section 10-02.3 for minimum length of vertical curves on ramps.

LENGTH OF SAG VERTICAL CURVES:



$$\text{If } SDs < Ls \text{ Then } Ls = \frac{A(SDs)^2}{400 + 3.5(SDs)}$$

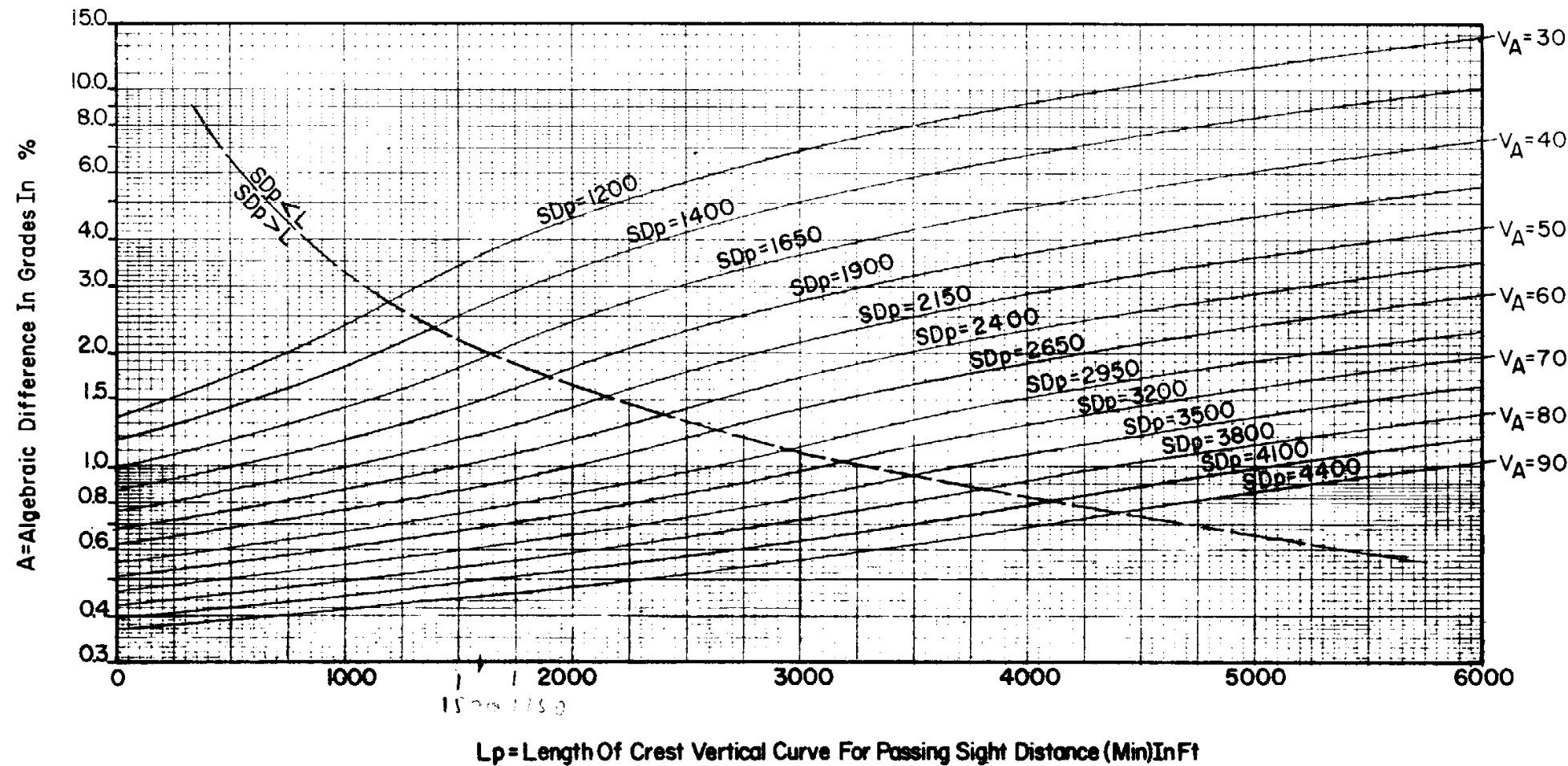
$$\text{If } SDs > Ls \text{ Then } Ls = 2(SDs) - \frac{400 + 3.5(SDs)}{A}$$

Ls = Length Of Sag Vertical Curve In Feet (Min)

SDs = Sight Distance, Stopping, In Feet

A = Algebraic Difference In Grade In Percent Form

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APPROVED FOR DISTRIBUTION 		
LENGTH STANDARDS SAG VERTICAL CURVES		PLAN NO. D-51.30



NOTE: Minimum Length of Vertical Curves:
 1000ft. for Interstate Highways.
 800 ft. for Primary and Secondary Hwys.
 3 Times Design Speed in MPH for all other roadways.

Speeds indicated are for the vehicle being passed.
 The passing vehicle is assumed to be moving 10 MPH faster.

See "Manual of Highway Geometric Design," ADOT, Section 7-06 for general explanation and Section 10-02.3 for minimum length of vertical curves on ramps.

LENGTH OF CREST VERTICAL CURVE FOR PASSING SIGHT DISTANCE:

IF $SD_p < L_p$ Then $L_p = \frac{A(SD_p)^2}{3295}$

IF $SD_p > L_p$ Then $L_p = 2(SD_p) - \frac{3295}{A}$

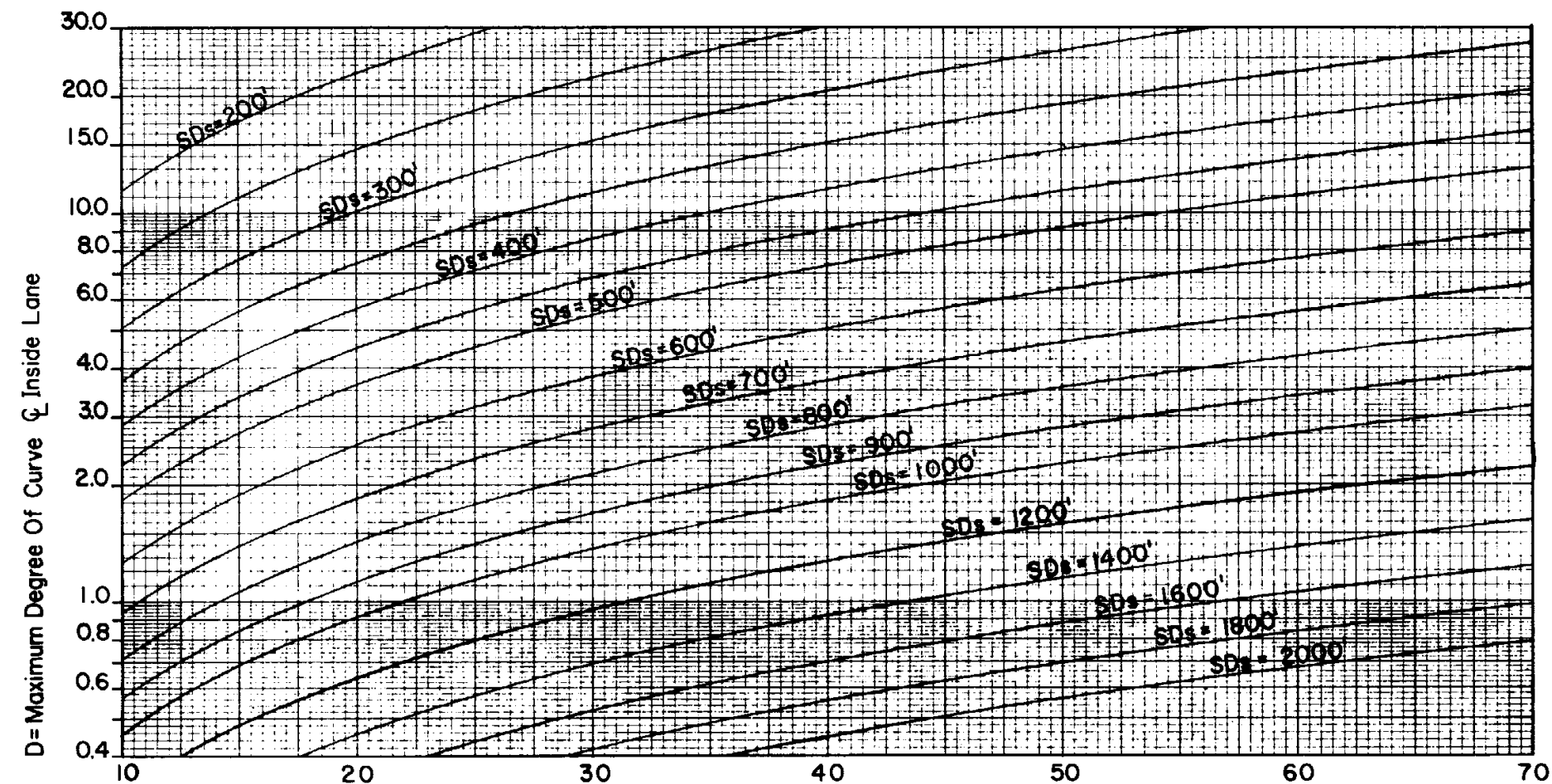
L_p = Length Of Crest Vertical Curve For Passing Sight Distance In Feet (Min)

SD_p = Sight Distance, Passing, In Feet

A = Algebraic Difference In Grade In Percent Form

V_A = Assumed Speed For Wet Conditions In MPH

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APPROVED FOR DISTRIBUTION 	PASSING SIGHT DISTANCE CREST VERTICAL CURVES	PLAN NO. D-51.40	



NOTE: See D-51.10 for Sight Distance, Stopping (SDs)

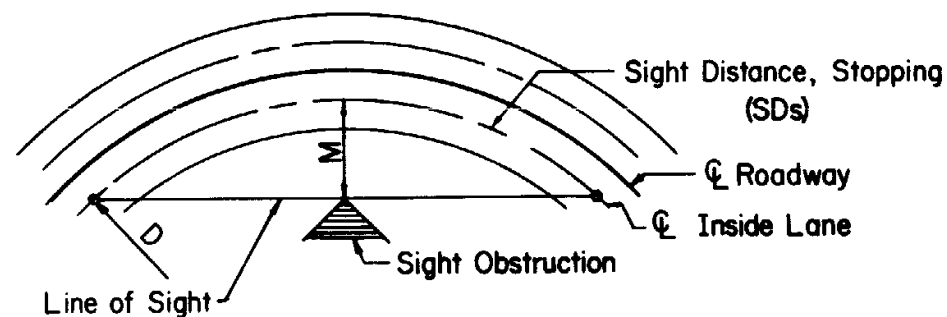
See D-56.10, D-56.20 and D-56.30 for Degree of Curvature and Superelevation.

See "Manual of Highway Geometric Design," ADOT, Section 7-08 for explanation.

MIDDLE ORDINATE:

$$M = \frac{5730}{D} \text{ VERS } \frac{(SDs)D}{200}$$

M = Length Of Middle Ordinate In Feet (Min)
SDs = Sight Distance, Stopping, In Feet
D = Maximum Degree Of Curvature On Center Line Of Inside Lane



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STOPPING SIGHT DISTANCE
HORIZONTAL CURVES

PLAN NO.

D-51.50

BASIC PROCEDURE

GIVEN: Terrain Class, Design Speed, ADT (Average Daily Traffic), K (Design Hour Factor), T (% Trucks & Recreation Vehicle) and D (% Directional Distribution Factor) or % Passing Sight Distance > 1500 Ft.

FIND: The geometric design standard (roadway with the minimum cross section) that satisfies the given criteria.

STEPS

1. Compute DHV in 100's = $ADT \times K \times 0.01$
2. Enter the table in the appropriate terrain class column.
3. Within the terrain class column find the appropriate T (% Trucks) column.
4. Within the appropriate D or % Passing Sight Distance column find the range of smallest DHV values which will satisfy the value for DHV as computed in Step 1. Note that both given design speed and either D or % Passing Sight Distance must be satisfied.
5. The minimum geometric design standard is indicated by the "R" number associated with the result of Step 4.
6. The details of the geometric design standard found in Step 5 are shown on Std. D-52.20

Note: All DHV's computed in these procedures are two-way.

EXAMPLE NO. 1

GIVEN: Terrain = Rolling, Design Speed = 60 mph, ADT = 6000, K = 8%, T = 5%, Passing Sight Distance = 60% > 1500 Feet.

Solution:

1. $DHV = 6000 \times 0.08 \times 0.01 = 4.8$
2. Enter "Rolling" terrain class column.
3. Within the above column find the T% column group which contains the given value of 5% (0% to 9% group).
4. Within the column group found in Step 3 find that column which contains the % passing sight distance value of 60%.
5. Within the above column find the range of smallest DHV which contains the value 4.8 (from Step 1).
6. The "R" number to the left is found to be R3, the geometrics for which may be found on Std. D-52.20

Comment:

It will be noticed that cross section R5 will also satisfy the DHV criteria if a 50 mph design speed is permissible. A re-evaluation of the basic criteria may find such a revision advisable.

MULTI-LANE

Terrain		Level									Rolling									Mountainous									
% Trucks (T)	Max	9			15			20			9			15			20			9			15			20			
	Min	0			10			16			0			10			16			0			10			16			
% Directional Distribution D	Max	60	70	80	60	70	80	60	70	80	60	70	80	60	70	80	60	70	80	60	70	80	60	70	80				
	Min	50	61	71	50	61	71	50	61	71	50	61	71	50	61	71	50	61	71	50	61	71	50	61	71				
R1	Design Speed		80 mph (Level of Service B)									70 mph (Level of Service B)									60 mph (Level of Service C)								
	DHV Range (100's)	Max	32	27	24	29	24	21	28	24	20	31	26	22	25	21	18	23	19	17	21	18	15	13	11	10	11	9	8
		Min	23	20	17	22	19	16	21	18	15	20	17	15	16	14	12	14	12	11	10	9	8	9	8	7	8	7	6
R2	Design Speed		70 mph (Level of Service B)									60 mph (Level of Service B)									50 mph (Level of Service C)								
	DHV Range (100's)	Max	22	19	16	21	18	15	20	17	14	19	16	14	15	13	11	13	11	10	17	14	12	10	8	7	8	6	5
		Min	17	14	12	16	13	12	15	13	11	12	10	9	11	9	8	10	8	7	8	7	6	6	5	5	5	5	4

2-LANE

Terrain			Level									Rolling									Mountainous									
% Trucks (T)		Max	9			15			20			9			15			20			9			15			20			
		Min	0			10			16			0			10			16			0			10			16			
R3	% Passing Sight Dist.		100	80	60	100	80	60	100	80	60	80	60	40	80	60	40	80	60	40	60	40	20	60	40	20	60	40	20	
	Design Speed		70 mph (Level of Service B)									60 mph (Level of Service B)									50 mph (Level of Service C)									
	DHV Range (100's)		Max	7.5	7.0	6.5	6.5	6.0	5.5	6.2	5.5	5.2	6.0	5.1	4.1	4.2	3.5	2.9	3.6	3.1	2.5	8.0	6.4	4.7	4.2	3.4	2.5	3.2	2.6	1.9
			Min	6.0	5.5	5.0	5.5	5.2	4.7	5.2	4.6	4.4	3.9	3.4	2.7	3.3	2.8	2.3	3.0	2.6	2.0	3.9	3.2	2.3	3.0	2.4	1.8	2.6	2.1	1.5
R4	% Passing Sight Dist.		100	80	60	100	80	60	100	80	60	80	60	40	80	60	40	80	60	40	40	20	0	40	20	0	40	20	0	
	Design Speed		70 mph (Level of Service B)									60 mph (Level of Service B)									50 mph (Level of Service C)									
	DHV Range (100's)		Max	7.2	6.7	6.1	6.4	5.9	5.4	6.0	5.6	5.0	5.5	4.7	3.7	4.1	3.5	2.8	3.5	3.1	2.4	5.4	4.0	2.6	3.2	2.4	1.5	2.5	1.9	1.2
			Min	5.7	5.3	4.8	5.4	5.0	4.5	5.0	4.7	4.3	3.6	3.1	2.5	3.1	2.7	2.2	2.8	2.4	2.0	3.0	2.2	1.4	2.3	1.7	1.1	2.0	1.5	1.0
R5	% Passing Sight Dist.		100	80	60	100	80	60	100	80	60	80	60	40	80	60	40	80	60	40	40	20	0	40	20	0	40	20	0	
	Design Speed		60 mph (Level of Service B)									50 mph (Level of Service C)									40 mph (Level of Service D)									
	DHV Range (100's)		Max	5.4	4.7	4.0	4.7	4.1	3.6	4.5	3.9	3.4	6.9	6.2	5.0	5.1	4.5	3.7	4.5	4.0	3.2	5.6	4.4	2.4	3.0	2.3	1.3	2.3	1.8	1.0
			Min	4.3	3.7	3.2	4.0	3.5	3.0	3.8	3.3	2.8	4.6	4.1	3.3	4.0	3.6	2.9	3.6	3.2	2.6	2.7	2.1	1.1	2.1	1.6	0.9	1.8	1.4	0.7

EXAMPLE NO. 2

GIVEN: Terrain = Rolling, Design Speed = 70 mph, ADT = 22000, K = 11%, T = 8%, D = 55%.

Solution:

1. $DHV = 22000 \times 0.11 \times 0.01 = 24$
2. Enter "Rolling" terrain class column.
3. Within the above column find the T% column group which contains the given value of 8% (0% - 9% group).
4. Within the column group found in Step 3 find that column which contains the D value of 55% (50% - 60% column).
5. Within the above column find the range of smallest DHV which contains the value 24 (from Step 1).
6. The "R" number to the left is found to be R1, the geometrics for which may be found on Std. D-52.20

GENERAL NOTES

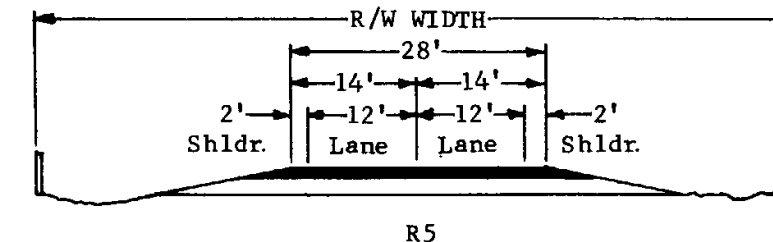
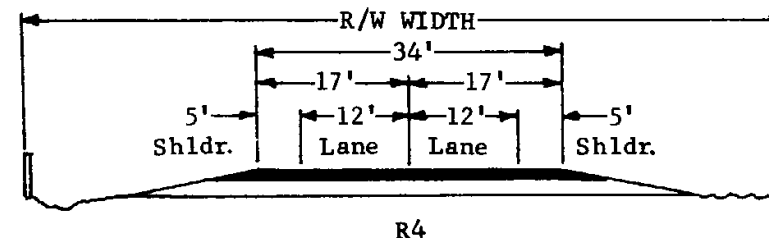
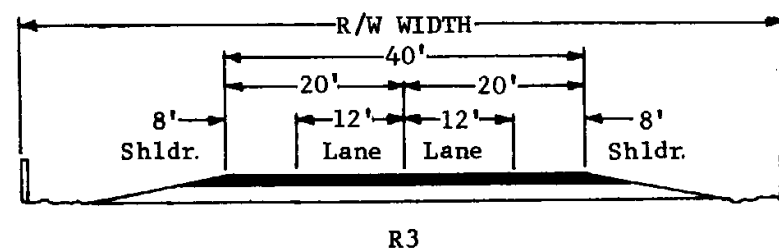
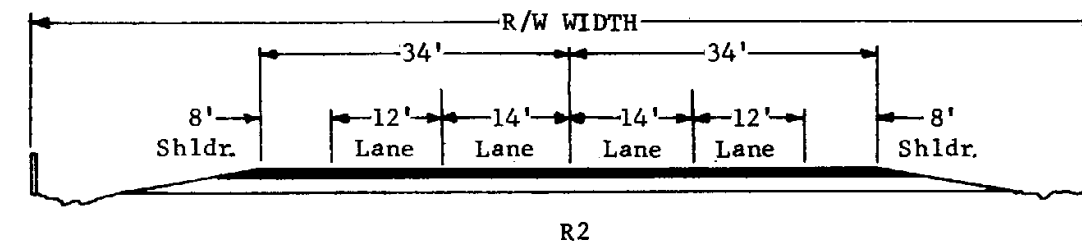
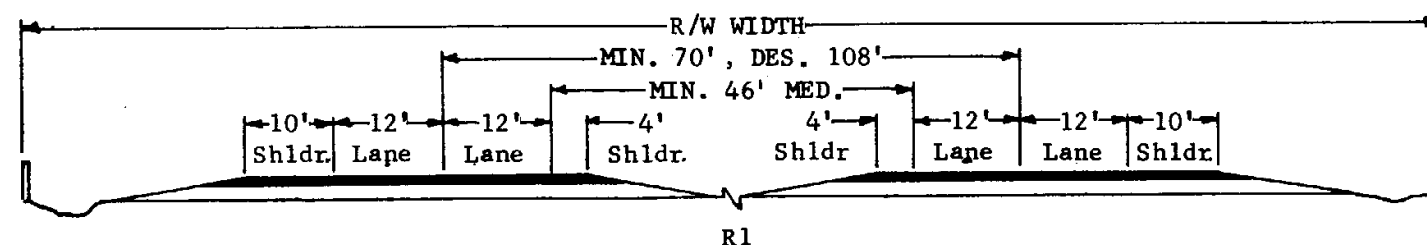
The procedures will in some instances yield results which can be satisfied by more than one design standard. Final selection will require careful consideration of factors such as operation, economics, local influences, etc.

Note that multi-lane vs. 2-lane standards are differentiated by directional distribution vs. % passing sight distance > 1500 feet.

All DHV's computed in these procedures are two-way.

RURAL & RURAL CHARACTER HIGHWAYS

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APPROVED FOR DISTRIBUTION <i>[Signature]</i>	GEOMETRIC DESIGN SELECTION TABLE & PROCEDURES	PLAN NO. D-52.10



Design Cross Section	R1			R2			R3			R4			R5		
Number of Traffic Lanes	4-DIVIDED			4-UNDIVIDED			2			2			2		
Terrain	LEVEL	ROLL.	MTN.	LEVEL	ROLL.	MTN.	LEVEL	ROLL.	MTN.	LEVEL	ROLL.	MTN.	LEVEL	ROLL.	MTN.
Median Width & Roadway Width	See Cross Sections Above and Sections 8-11 and 8-12 of Design Manual														
Design Speed - m.p.h.	80	70	60	70	60	50	70	60	50	70	60	50	60	50	40
Maximum Curvature - Degrees	See Standards D-56.10, D-56.20 & D-56.30														
Desirable Maximum Curvature - Degrees	1	2	4	1	2	4	2	4	6	2	4	6	6	8	14
Minimum Stopping Sight Distance - Eye to 6" Object	900	675	500	900	675	500	675	500	375	675	500	375	500	375	275
Passing Sight Distance - Eye to Eye	-	-	-	3100	2700	2300	2700	2300	1900	2700	2300	1900	2300	1900	1550
Maximum Grade - %	3	4	6	3	4	6	3	4	6	4	6	8	4	6	8
Desirable Maximum Grade - %	2	3	4	2	3	4	3	4	4	3	5	6	3	5	7
Minimum R/W Width - Ft.	260	260	260	200	200	200	200	200	200	100	100	100	100	100	100
Desirable Minimum R/W Width - Ft.	308	308	308	250	250	250	250	250	250	200	200	200	-	-	-

GENERAL NOTES

LEVEL TERRAIN: Any combination of geometric design elements that permits trucks to maintain speeds that equal or approach speeds of passenger cars.

ROLLING TERRAIN: Any combination of geometric design elements that causes trucks to reduce speed substantially below that of passenger cars on some sections of the highway but which does not involve sustained crawl speeds by trucks for any substantial distance.

MOUNTAINOUS TERRAIN: Any combination of geometric design elements that will cause trucks to operate at crawl speed for considerable distances or at frequent intervals.

DESIRABLE is the standard to be attained if physical features permit.

PASSING SIGHT DISTANCES less than those tabulated are permitted but are to be avoided if possible.

ROADWAY WIDTH on structures shall be increased by two feet on each side for geometric design standards R1 through R4. For geometric design standard R5 the structure width may be greater than the approach roadway, but in no case shall it be less.

CURVE SUPERELEVATION shall be in accordance with standards D-56.10 through D-56.40.

For Geometric Design Standard Selection Procedure, see Standard D-52.10.

RURAL & RURAL CHARACTER HIGHWAYS

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APPROVED FOR DISTRIBUTION <i>[Signature]</i>	GEOMETRIC DESIGN STANDARDS	DRAWING NO. D-52.20

Location		Urban (30-50 mph)									Suburban (40-60 mph)								
% Trucks		0 - 5			6 - 10			11 - 15			0 - 5			6 - 10			11 - 15		
Directional		50	61	71	50	61	71	50	61	71	50	61	71	50	61	71	50	61	71
Distribution		to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
		60	70	80	60	70	80	60	70	80	60	70	80	60	70	80	60	70	80
U1	Turn & Park Criteria	60% Green Time, Lt. Turn Arrow, Turns: 10% Lt., 10% Rt. No Parking in Outer Lanes. Distress Only.																	
	Design Hourly	40	32	28	37	31	26	35	28	25	37	31	26	35	28	24	33	27	23
	Volume (100's)	tp	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
U2	Turn & Park Criteria	60% Green Time, Lt. Turn Arrow, Turns: 10% Lt., 10% Rt. No Parking in Outer Lanes. Distress Only.																	
	Design Hourly	31	25	22	30	24	21	28	23	20	30	24	21	28	23	20	27	22	19
	Volume (100's)	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
U3	Turn & Park Criteria	60% Green Time, Lt. Turn Arrow, Turns: 10% Lt., 10% Rt. No Parking in Outer Lanes. Distress Only.																	
	Design Hourly	26	22	19	25	20	17	23	19	16	25	20	17	23	19	17	22	18	16
	Volume (100's)	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
U4	Turn & Park Criteria	50% Green Time, Turns: 10% Lt., 10% Rt. Parking in Outer Lanes.																	
	Design Hourly	17	14	12	16	13	11	15	13	11	16	13	11	15	13	11	15	12	10
	Volume (100's)	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
U5	Turn & Park Criteria	50% Green Time, Turns: 10% Lt., 10% Rt. No Parking in Outer Lanes.																	
	Design Hourly	18	15	13	17	14	12	16	13	11	17	14	12	16	13	11	15	13	11
	Volume (100's)	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to

GENERAL NOTES

PROCEDURE

GIVEN: Design Speed, ADT (Average Daily Traffic), K (Design Hour Factor), T (% Trucks), D (Directional Distribution) and whether classified as Urban or Suburban.

FIND: The Geometric Design Standard (roadway with the minimum cross section) that satisfies the given criteria

STEPS

1. Compute DHV in 100's
= ADT x K x 0.01.
2. Enter the table in the appropriate urban or suburban column.
3. Within the location class column find the appropriate T (% Trucks) column.
4. Within the appropriate D (% Directional Distribution) column, find the range of smallest DHV values which will satisfy the DHV value computed in Step 1. Note that the given design speed must be satisfied.
5. The minimum Geometric Design Standard is indicated by the "U" number associated with the results of Step 4.
6. The details for the Geometric Design Standard found in Step 5 are shown in Standard D-52.40.

Note:

All DHV's computed in these procedures are two-way.

EXAMPLE

GIVEN: Location Class = Suburban
Design Speed = 55 mph
ADT = 18,500
K = 12%
T = 7%
D = 55%

1. DHV = 18,500 x 12 x 0.01 = 22
2. Enter Suburban column.
3. Within the above column, find the T% group which contains the given T value (6% to 10% column).
4. Within the column group found in Step 3 find the column which contains the D value of 55% (50% to 60% column).
5. Within the above column group, find the smallest DHV range which contains the value 22 (from Step 1).
6. The "U" number to the left is found to be U3, the geometrics for which may be found on Standard D-52.40.

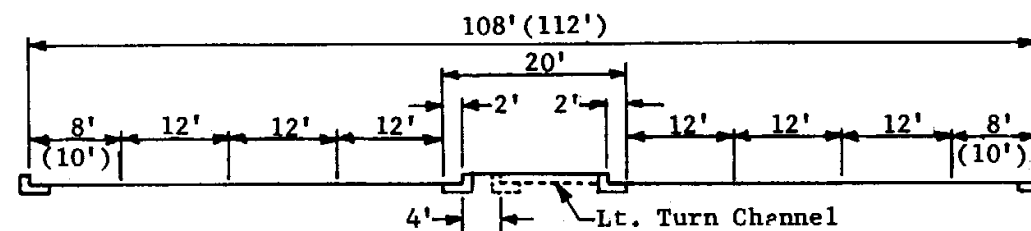
The procedures may in some instances yield results which can be satisfied by more than one geometric standard. Final selection will require careful consideration of factors such as operation, economics, local influences, etc.

A capacity analysis should be performed in those instances where the variables (% green time, % turning movements, etc.) are known to differ appreciably from the average values tabulated.

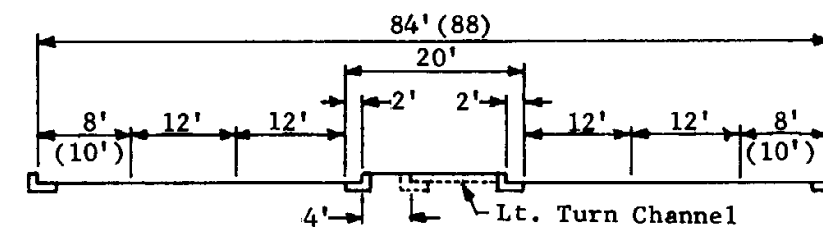
Standard U5 may be modified to serve in situations where it appears that two through traffic lanes would be adequate into the near future and it has been determined that on street parking would be temporarily acceptable. Under these conditions the cross section would be composed of two 16 foot traffic lanes with two 10 foot parking lanes. Traffic carrying capability would be determined by multiplying the appropriate U5 tabular design hourly volume by 65%.

URBAN & SUBURBAN HIGHWAYS

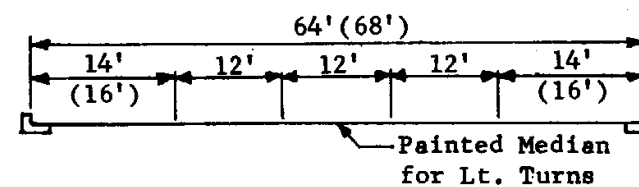
DESIGN APPROVED <i>JP Gaby</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS GUIDE	REV. 1/82
APPROVED FOR DISTRIBUTION <i>Walter Ford</i>	GEOMETRIC DESIGN SELECTION TABLE & PROCEDURES	DRAWING NO. D-52.30



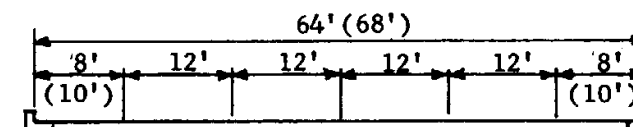
U1



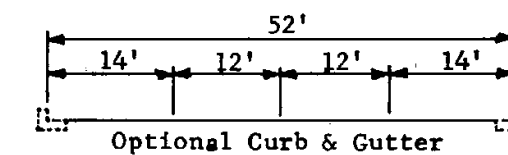
U2



U3



U4



U5

Design Cross Section	U1		U2		U3		U4		U5	
Location	Urban	Suburban	Urban	Suburban	Urban	Suburban	Urban	Suburban	Urban	Suburban
Number of Traffic Lanes	6	6	4	4	4	4	4	4	4	4
Traffic Lane Width - Ft.	12	12	12	12	12	12	12	12	12	12
Median Width - Ft.	20	20	20	20	12	12	-	-	-	-
Minimum Outer Lane Width - Ft.	8	8	8	8	14	14	8	8	14	14
Minimum Desirable Outer Lane Width - Ft.	10	10	10	10	16	16	10	10	14	14
Minimum Roadway Width Incl. Paved Shoulders - Ft.	108	108	84	84	64	64	64	64	52	52
Minimum Desirable Roadway Width Incl. Paved Shoulders - Ft.	112	112	88	88	68	68	68	68	52	52
Design Speed - mph	30-50	40-60	30-50	40-60	30-50	40-60	30-50	40-60	30-50	40-60
Maximum Curvature - Degrees	8	6	8	6	8	6	8	6	8	6
Desirable Maximum Curvature - Degrees	7	5	7	5	7	5	7	5	7	5
Minimum Curb Return Radius - Ft.	20	20	20	20	20	20	20	20	20	20
Minimum Stopping Sight Distance - Eye to 6' Object	375	500	375	500	375	500	375	500	375	500
Maximum Grade - %	6	6	6	6	6	6	6	6	6	6
Desirable Maximum Grade - %	4	4	4	4	4	4	4	4	4	4
Minimum R/W Width - Ft.	135	135	100	100	90	90	90	90	80	80
Desirable Minimum R/W Width - Ft.	300	300	250	250	200	200	200	200	190	190

DESIRABLE is the standard to be attained if physical features permit.

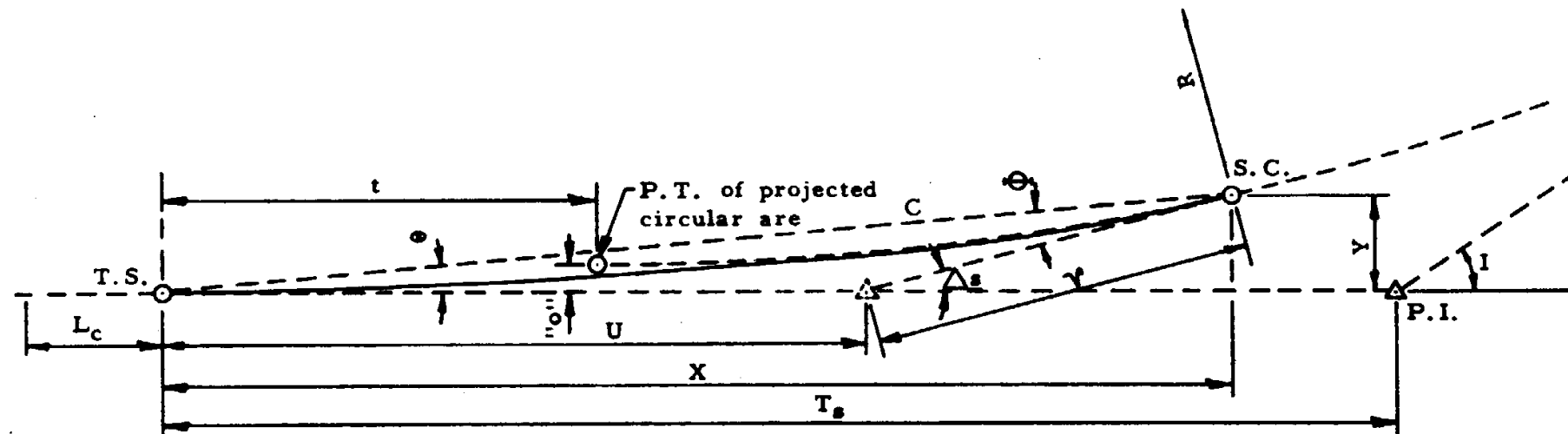
ROADWAY WIDTH on structures shall match that of approach roadway.

CURVE SUPERELEVATION shall be in accordance with standards D-56.10 through D-56.40 subject to adjustments necessary to assuring reasonable ingress and egress to adjacent properties.

For Geometric Design Standard Selection Procedure, see Standard D-52.30.

URBAN & SUBURBAN HIGHWAYS

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Determine values of L_s and a , for design speed and D , from Drwg. Nos. D-56.10 through D-56.30. These values may be checked by the following applicable formulae.

L_s (sta.) = Spiral distance from T.S. to S.C. = D/a
 a (degrees) = Rate of change in degree of curvature per 100' of spiral = D/L_s

D (degrees) = Degree of curvature of circular curve
 $= aL_s = 5729.58/R$

R (ft.) = Radius of circular curve = $5729.58/D$

"o" (ft.) = Radial offset = $0.0727aL_s^3$

t (ft.) = $50L_s - 0.000127a^2L_s^3$

Δ_s (degrees) = Full spiral deviation angle = $\frac{1}{2}aL_s^2$
 $= \frac{1}{2}DL_s = \frac{1}{2}(D^2/a) = L_s/2(D)$

Θ (degrees) = Full spiral deflection angle at T.S.
 $= (1/3\Delta_s)^\circ = 1/6aL_s^2 = 1/6DL_s = 1/6D^2/a^\circ$

$\frac{1}{2}\Theta$ (degrees) = Full spiral deflection angle at S.C.
 $= \Delta_s - \Theta$

C (ft.) = $100 L_s - 0.00034a^2L_s^5$

V (ft.) = $C \sin \Theta / \sin \Delta_s$

U (ft.) = $C \sin \frac{1}{2}\Theta / \sin \Delta_s$

X (ft.) = $C \cos \Theta$

Y (ft.) = $C \sin \Theta$

T_s (ft.) = $[(\tan \frac{1}{2}I)(R + "o")] + t$

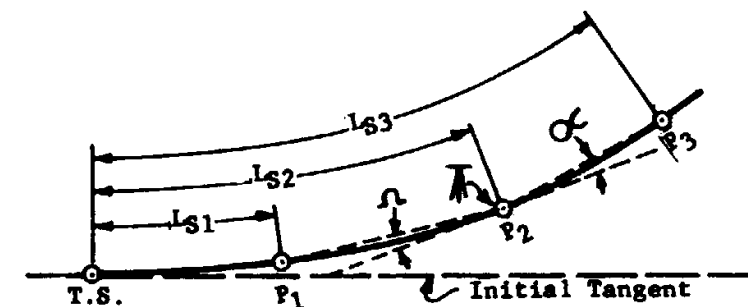
SPIRAL FORMULAE

Reduce Θ formulae values by C_n according to the following table:

Δ_s	C_n	Δ_s	C_n	Δ_s	C_n
16°	0.2	31°	1.6	46°	5.1
17	0.3	32	1.7	47	5.5
18	0.3	33	1.9	48	5.8
19	0.4	34	2.1	49	6.2
20	0.4	35	2.3	50	6.6
21	0.5	36	2.5	51	7.0
22	0.6	37	2.7	52	7.4
23	0.6	38	2.9	53	7.9
24	0.7	39	3.1	54	8.3
25	0.8	40	3.4	55	8.8
26	0.9	41	3.6	56	9.3
27	1.0	42	3.9	57	9.8
28	1.2	43	4.2	58	10.3
29	1.3	44	4.5	59	10.8
30	1.4	45	4.8	60	11.4

° VALUES OF C_n IN Θ DETERMINATION FORMULAE

(C_n is negligible and may be ignored for Δ_s values less than 16°.)



$$\alpha = \frac{1}{2}aL_s^2(L_{s3} - L_{s2}) + 1/6a(L_{s3} - L_{s2})^2$$

$$\beta = \frac{1}{2}aL_s^2(L_{s2} - L_{s1}) - 1/6a(L_{s2} - L_{s1})^2$$

DEFLECTION ANGLE FORMULAE FOR SET-UP AT POINT ON SPIRAL

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Select L_s and a from Drwg. No. D-56.10 through D-56.30 for the specified design speed and $D=D_2$. These values may be checked by the applicable following formulae.

$L_s(\text{sta.}) = \text{Length of spiral from } D_2 \text{ to S.T.} = D_2/a$

$a(\text{degrees}) = \text{Rate of change in degree of curvature per } 100' \text{ of spiral} = D_1/L_1 = D_2/L_s$

$\Theta(\text{degrees}) = \text{Deflection for spiral having values of } a \text{ and } L_s - L_1 = 1/6a(L_s - L_1)^2$

$L_1(\text{sta.}) = \text{Length of spiral from } D_1 \text{ to S.T.} = D_1/a$

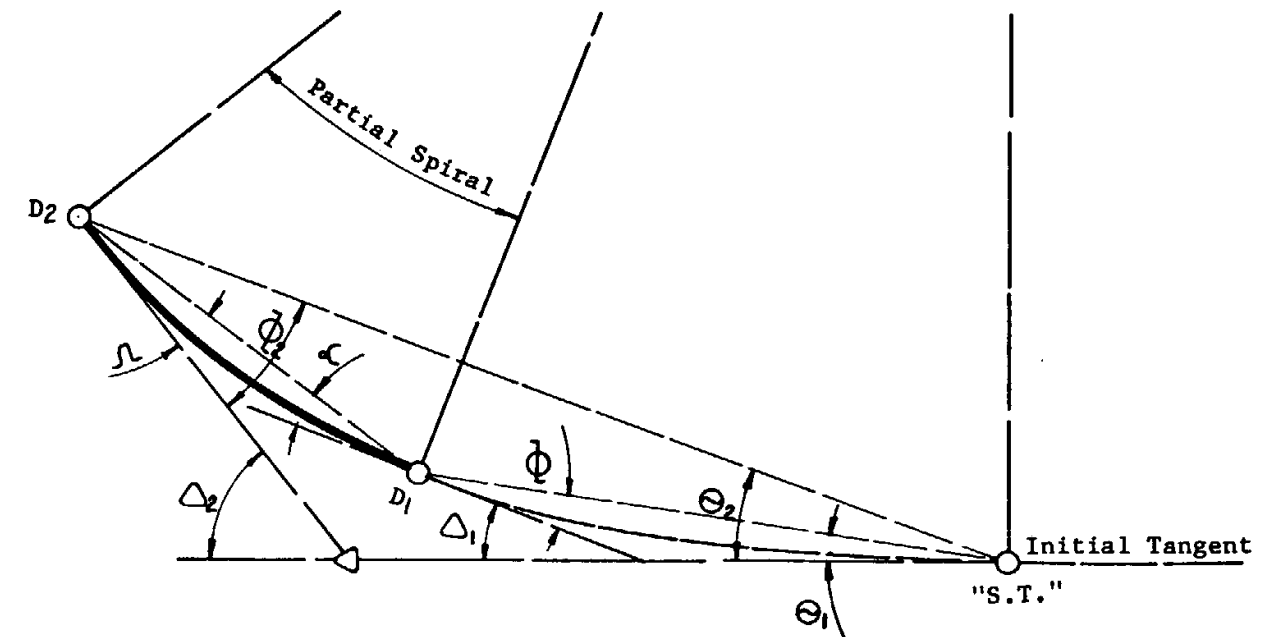
$L_s - L_1(\text{sta.}) = \text{Length of spiral from } D_2 \text{ to } D_1 = D_2 - D_1/a$

$D_1(\text{degrees}) = \text{Culminating degree of curvature at } D_1 = aL_1 = D_2 - a(L_s - L_1)$

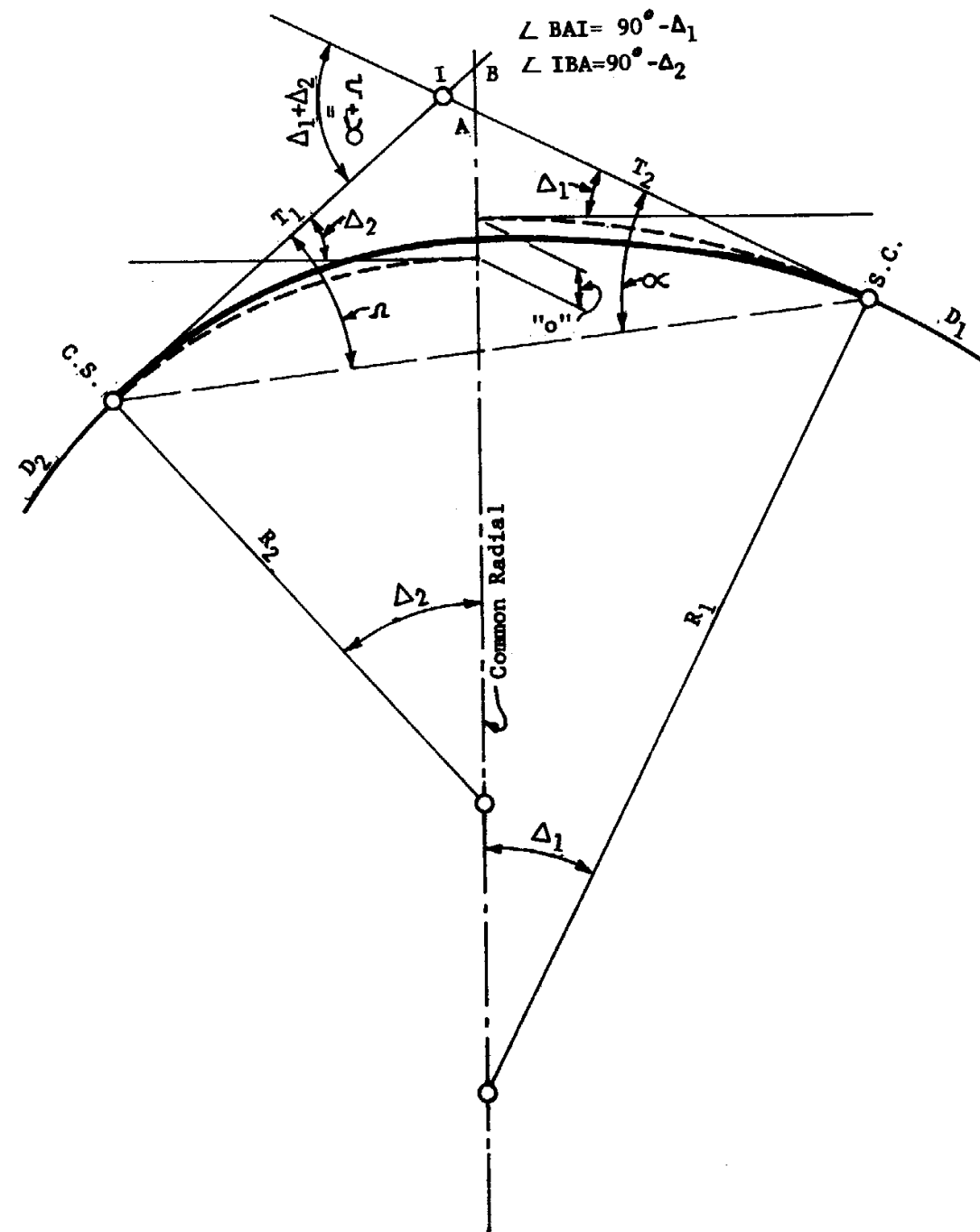
$D_2(\text{degrees}) = \text{Culminating degree of curvature at } D_2 = aL_s = D_1 + a(L_s - L_1)$

$\alpha(\text{degrees}) = \frac{1}{2}aL_1(L_s - L_1) + 1/6a(L_s - L_1)^2 = \frac{1}{2}D_1 \left[\frac{D_2 - D_1}{a} \right] + 1/6a \left[\frac{D_2 - D_1}{a} \right]^2 = \frac{1}{2}D(L_s - L_1) + \Theta$

$\Delta(\text{degrees}) = \frac{1}{2}aL_s(L_s - L_1) - 1/6a(L_s - L_1)^2$
 $= \frac{1}{2}D_2 \left[\frac{D_2 - D_1}{a} \right] - 1/6a \left[\frac{D_2 - D_1}{a} \right]^2$
 $= \frac{1}{2}D_2(L_s - L_1) - \Theta$



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APPROVED FOR DISTRIBUTION <i>W. H. Smith</i>	PARTIAL TRANSITION SPIRAL	PLAN NO. D-55.20



Intermediate Spiral Transition is basically the same as Partial Transition Spiral illustrated by Drwg. No D-55.20.

Select L_s and a from Drwg. No. D-56.10. through Drwg. No. D-56.30 for design speed and $D=D_1-D_2$. These values are applied throughout the following formulae.

$$L_s(\text{sta.}) = (D_2 - D_1) / a$$

$$a(\text{degrees}) = (D_2 - D_1) L_s$$

$$D_p(\text{sta.}) = \text{Degree of curvature at any point on spiral.}$$

$$= D_2 - (a)(\text{distance in sta. from C.S. to point}).$$

$$= D_1 + (a)(\text{distance in sta. from S.C. to point}).$$

$$"o"(\text{ft.}) = 0.0727(D_2 - D_1) \left(\frac{D_2 - D_1}{a} \right)^2$$

$$\Delta_1(\text{degrees}) = 1/2 D_2 \left(\frac{D_2 - D_1}{a} \right) - 1/6 a \left(\frac{D_2 - D_1}{a} \right)^2$$

$$\Delta_2(\text{degrees}) = 1/2 D_1 \left(\frac{D_2 - D_1}{a} \right) + 1/6 a \left(\frac{D_2 - D_1}{a} \right)^2$$

To calculate deflections and spiral distance to any point on spiral, substitute D_p for D_1 or D_2

$$\Delta_1 = (\text{degrees}) = D_1(L_s/2)$$

$$\Delta_2 = (\text{degrees}) = D_2(L_s/2)$$

$$AB = R_2 \text{ in feet (exsec. } \Delta_2) - R_1 \text{ in feet (exsec. } \Delta_1) - "o"$$

$$AI(\text{ft.}) = AB \left[\frac{\cos \Delta_2}{\sin(\Delta_1 + \Delta_2)} \right]$$

$$BI(\text{ft.}) = AB \left[\frac{\cos \Delta_1}{\sin(\Delta_1 + \Delta_2)} \right]$$

$$T_1(\text{ft.}) = R_1 \text{ in feet } (\tan \Delta_1) + AI$$

$$T_2(\text{ft.}) = R_2 \text{ in feet } (\tan \Delta_2) - BI$$

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V=30					V=40				V=50				V=60				V=65				V=70				V=80			
D	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls
0-15	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	RC	1/8	100	200
0-30	NC	-	0	0	NC	-	0	0	NC	-	0	0	RC	1/3	75	150	RC	1/3	75	100	RC	1/3	75	150	.023	1/4	100	200
0-45	NC	-	0	0	NC	-	0	0	RC	1/2	50	150	.021	1/2	75	150	.023	1/2	75	150	.026	1/2	75	150	.033	1/3	100	225
1-00	NC	-	0	0	RC	1	50	100	.020	2/3	50	150	.027	2/3	75	150	.029	1/2	75	200	.033	1	75	200	.041	1/3	100	300
1-30	RC	1 1/2	50	100	.020	1 1/2	50	100	.028	1	50	150	.036	1	75	150	.040	3/4	75	200	.044	3/4	75	200	.053	1/2	100	300
2-00	RC	2	50	100	.026	2.0	50	100	.035	1 1/3	50	150	.044	1	75	200	.048	1	75	200	.052	1	75	200	.059	2/3	100	300
2-30	.020	2 1/2	50	100	.031	2 1/2	50	100	.040	1 2/3	50	150	.050	1 1/4	75	200	.053	1 1/4	75	200	.057	1	75	250	.060	2/3	100	375
3-00	.023	3	50	100	.035	2 1/2	50	120	.044	2	50	150	.054	1 1/2	75	200	.057	1 1/4	75	240	.059	1 1/4	75	280				
3-30	.026	3 1/2	50	100	.038	2 1/2	50	140	.048	2	50	175	.057	1 2/3	75	210	.059	1 1/4	75	280								
4-00	.029	4	50	100	.041	2 2/3	50	150	.051	2	50	200	.059	1 2/3	75	240	.060	1 1/3	75	300								
5-00	.034	5	50	100	.046	3 1/3	50	150	.056	2 1/2	50	200	.060	2	75	250												
6-00	.038	6	50	100	.050	4	50	150	.059	3	50	200																
7-00	.041	7	50	100	.054	4 2/3	50	150	.060	3 1/2	50	200																
8-00	.043	8	50	100	.056	5	50	160																				
9-00	.046	7 1/2	50	120	.058	5	50	180																				
10-00	.048	6 2/3	50	150	.059	5	50	200																				
11-00	.050	6 7/8	50	160	.060	5 1/2	50	200																				
12-00	.052	7 1/2	50	160																								
13-00	.053	8 1/8	50	160																								
14-00	.055	8 3/4	50	160																								
16-00	.058	10	50	160																								
18-00	.059	10	50	180																								
20-00	.060	10	50	200																								

D max. = 20°

D max. = 11°

Use spirals below heavy line,
circular curves above.

D max. = 7°

D max. = 5°

D max. = 4°

D max. = 3°

D max. = 2° 30'

NOTE: Tabular Lc and Ls values are for a 1 or 2 lane roadway
with the axis of rotation at the construction ϵ or either edge.

For Lc and Ls values for other lane multiples and for super
distribution data, see Std. D-56.40

Interpolate for values not shown.

Use judgment combined with local climatic
information in the choice of a maximum
superelevation for borderline roadway
elevations.

a = Increase in degree of curvature per 100' of spiral
D = Degree of curvature
e = Superelevation in ft./ft.
Lc = Normal crown runoff in feet
Ls = Superelevation runoff in feet
NC = Maintain normal crown
RC = Remove adverse crown and superelevate to normal crown slope

For elevations over 6000'
Definite Snow & Ice Conditions
Max. Super. = 0.06 ft/ft.

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	V=30				V=40				V=50				V=60				V=65				V=70				V=80			
D	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls
0-15	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	RC	1/4	100	200
0-30	NC	-	0	0	NC	-	0	0	NC	-	0	0	RC	1/3	75	150	RC	1/3	75	150	RC	1/3	75	150	.024	1/3	100	200
0-45	NC	-	0	0	NC	-	0	0	RC	1/2	50	150	.022	1/2	75	150	.025	1/2	75	150	.029	1/2	75	150	.036	1/3	100	225
1-00	NC	-	0	0	RC	1	50	100	.021	2/3	50	150	.029	2/3	75	150	.033	2/3	75	150	.038	2/3	75	150	.047	1/3	100	300
1-30	RC	1- 1/2	50	100	.021	1-1/2	50	100	.030	1	50	150	.040	1	75	150	.046	1	75	150	.053	1	75	150	.065	1/2	100	300
2-00	RC	2	50	100	.027	2	50	100	.038	1-1/3	50	150	.051	1-1/3	75	150	.057	1	75	200	.065	1	75	200	.076	2/3	100	300
2-30	.021	2-1/2	50	100	.033	2-1/2	50	100	.046	1-2/3	50	150	.060	1-1/4	75	200	.066	1-1/4	75	200	.073	1	75	250	.080	2/3	100	375
3-00	.025	3	50	100	.038	2-1/2	50	120	.053	2	50	150	.067	1-1/2	75	200	.073	1-1/3	75	225	.078	1	75	300	D max. = 2°-30'			
3-30	.028	3-1/2	50	100	.043	2-1/2	50	140	.058	2	50	175	.073	1-2/3	75	210	.077	1-1/4	75	280	.080	1	75	350				
4-00	.032	4	50	100	.047	3-1/3	50	140	.063	2	50	200	.077	1-2/3	75	240	.079	1-1/3	75	300	D max. = 3°-30'							
5-00	.038	5	50	100	.055	3-1/3	50	150	.071	2-1/2	50	200	.080	1-2/3	75	300	.080	1-2/3	75	300								
6-00	.043	5	50	120	.061	3-3/4	50	160	.077	3	50	200	D max. = 5°				D max. =5°											
7-00	.048	5	50	140	.067	4	50	175	.079	3-1/3	50	210																
8-00	.052	5-1/3	50	150	.071	4	50	200	.080	3-1/3	50	240	D max. = 8°															
9-00	.056	6	50	150	.075	4-1/2	50	200																				
10-00	.059	6-1/4	50	160	.077	5	50	200	D max. = 12°																			
11-00	.063	6-7/8	50	160	.079	5	50	220																				
12-00	.066	7-1/2	50	160	.080	5	50	240																				
13-00	.068	6-1/2	50	200																								
14-00	.070	7	50	200																								
16-00	.074	8	50	200																								
18-00	.077	9	50	200																								
20-00	.079	10	50	200																								
22-00	.080	10	50	220																								

NOTE: Tabular Lc and Ls values are for a 1 or 2 lane roadway with the axis of rotation at the construction \mathcal{C} or either edge.

For Lc and Ls values for other lane multiples and for super distribution data, see Std. D-56.40

Use spirals below heavy line, circular curves above.

D max. = 22°

- a = Increase in degree of curvature per 100' of spiral
D = Degree of curvature
e = Superelevation in ft. /ft.
Lc = Normal crown runoff in feet
Ls = Superelevation runoff in feet
NC = Maintain normal crown
RC = Remove adverse crown and superelevate to normal crown slope

Use spirals below heavy line,
circular curves above.



NOTE: Tabular Lc and Ls values are for a 1 or 2 lane roadway
with the axis of rotation at the construction \mathcal{C} or either edge.

For Lc and Ls values for other lane multiples and for super
distribution data, see Std. D-56.40

Interpolate for values not shown.

Use judgment combined with local climatic
information in the choice of a maximum
superelevation for borderline roadway
elevations.

For elevations from 4000' to 6000'
Possible Snow & Ice Conditions
Max. Super. = 0.08 ft/ft.

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	V=30				V=40				V=50				V=60				V=65				V=70				V=80			
D	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls	e	a	Lc	Ls
0-15	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	NC	-	0	0	RC	1/4	100	200
0-30	NC	-	0	0	NC	-	0	0	NC	-	0	0	RC	1/2	75	150	RC	1/3	75	150	RC	1/3	75	150	.024	1/3	100	200
0-45	NC	-	0	0	NC	-	0	0	RC	1/2	50	150	.024	2/3	75	150	.027	1/2	75	150	.029	1/2	75	150	.036	1/3	100	225
1-00	NC	-	0	0	RC	1	50	100	.023	2/3	50	150	.032	2/3	75	150	.035	2/3	75	150	.039	2/3	75	150	.048	1/3	100	300
1-30	RC	1 1/2	50	100	.021	1-1/2	50	100	.033	1	50	150	.046	1	75	150	.052	1	75	150	.058	3/4	75	200	.071	1/2	100	300
2-00	RC	2	50	100	.028	2	50	100	.042	1-1/3	50	150	.058	1-1/4	75	160	.066	1	75	200	.074	1	75	200	.089	2/3	100	300
2-30	.021	2-1/2	50	100	.034	2-1/2	50	100	.051	1-2/3	50	150	.069	1-1/4	75	200	.077	1	75	250	.086	1	75	250	.099	2/3	100	375
3-00	.025	3	50	100	.040	2-1/2	50	120	.059	2	50	150	.079	1-1/2	75	200	.087	1	75	300	.094	1	75	300	.100	2/3	100	450
3-30	.029	3-1/2	50	100	.046	2-1/2	50	140	.067	2	50	175	.087	1-1/4	75	280	.093	1	75	350	.099	2/3	75	375	D max. = 3°			
4-00	.033	4	50	100	.051	3-1/3	50	140	.073	2	50	200	.093	1-1/3	75	300	.098	1	75	400	.100	1	75	400				
5-00	.040	5	50	100	.061	3-1/3	50	150	.084	2-1/2	50	200	.099	1-2/3	75	300	.100	1	75	500	D max. = 4°				D max. = 5°			
6-00	.046	5	50	120	.070	3-3/4	50	160	.092	2-1/2	50	240	.100	1-2/3	75	360												
7-00	.053	5	50	140	.077	4	50	175	.098	2-1/2	50	280	D max. = 6°				D max. = 8°				D max. = 13°				Use spirals below heavy line, circular curves above.			
8-00	.059	5-1/3	50	150	.084	4	50	200	.100	2-1/2	50	320																
9-00	.064	6	50	150	.089	4-1/2	50	200	NOTE: Tabular Lc and Ls values are for a 1 or 2 lane roadway with the axis of rotation at the construction \mathcal{C} or either edge. For Lc and Ls values for other lane multiples and for super distribution data, see Std. D-56.40 Interpolate for values not shown.																			
10-00	.068	6-1/4	50	160	.093	5	50	200																				
11-00	.073	6-7/8	50	160	.097	5	50	220																				
12-00	.077	7-1/2	50	160	.099	5	50	240																				
13-00	.080	6-1/2	50	200	.100	5	50	260																				
14-00	.083	7	50	200																								
16-00	.089	8	50	200																								
18-00	.093	9	50	200																								
20-00	.097	10	50	200																								
22-00	.099	10	50	220																								
24-00	.100	10	50	240																								
25-00	.100	10	50	250																								

D max. = 25°

NOTE: Tabular Lc and Ls values are for a 1 or 2 lane roadway with the axis of rotation at the construction \mathcal{C}_L or either edge.

For Lc and Ls values for other lane multiples and for super distribution data, see Std. D-56.40

Interpolate for values not shown.



Use judgment combined with local climatic information in the choice of a maximum superelevation for borderline roadway elevations.

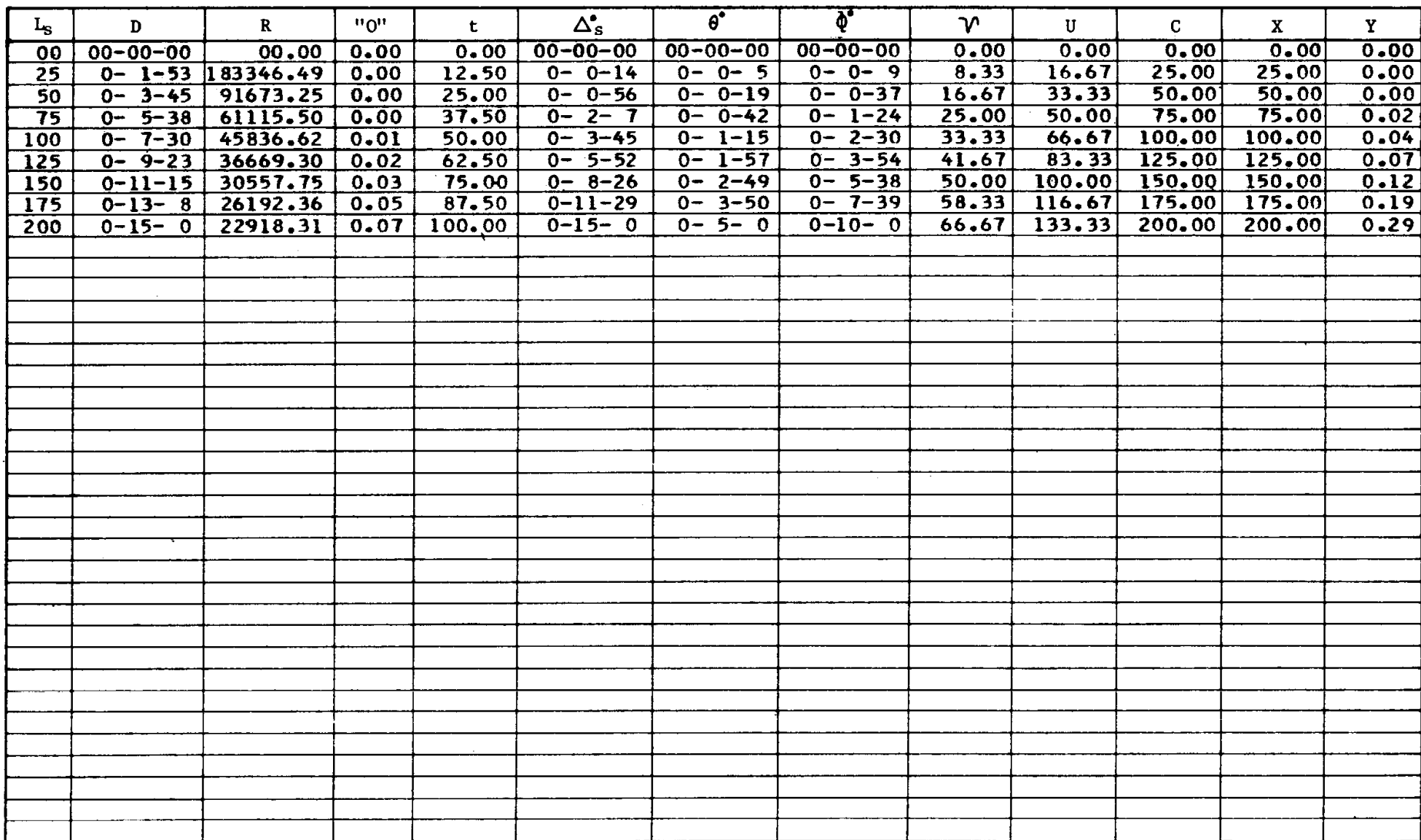
For elevations under 4000'

No Snow & Ice Conditions

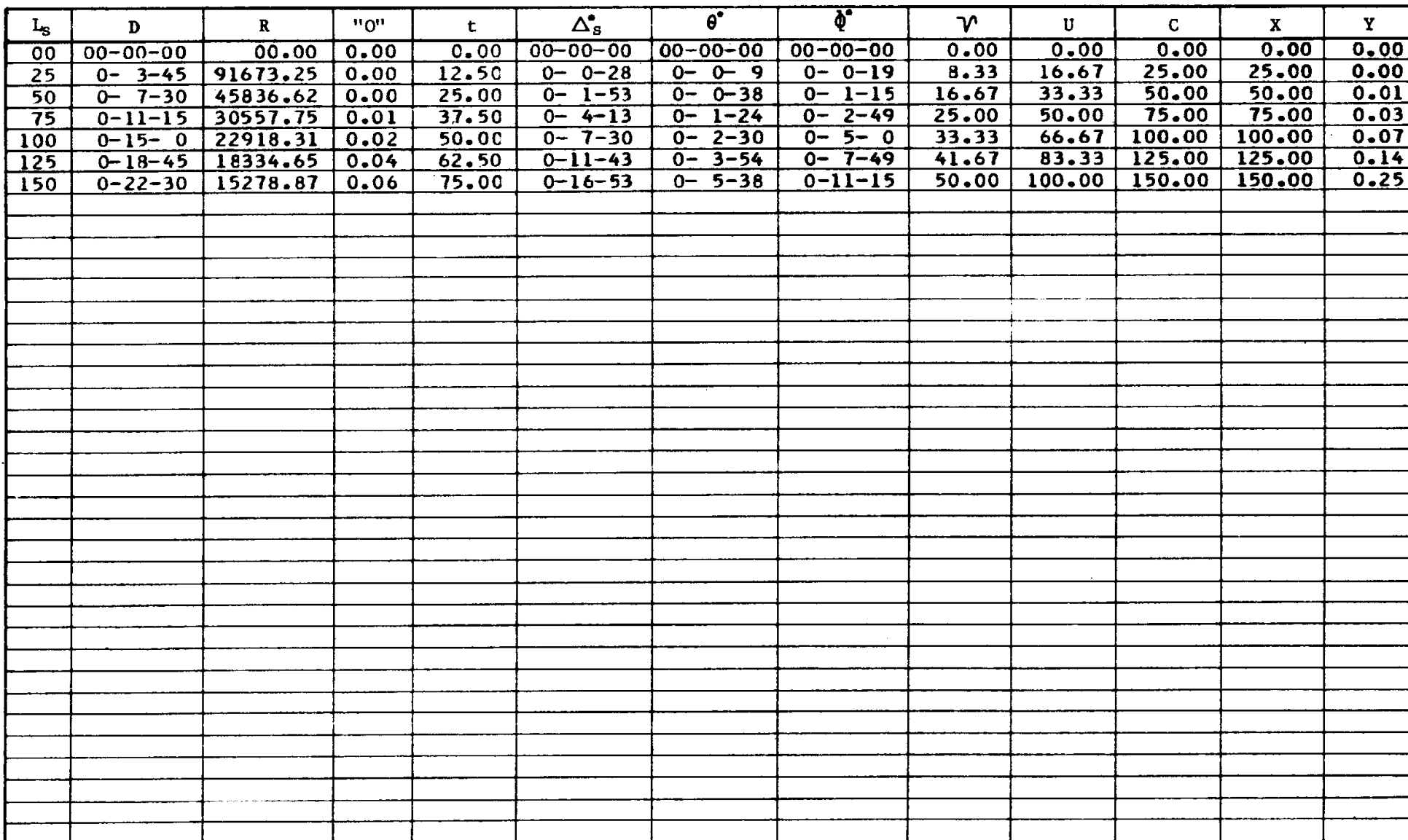
Max. Super. = 0.10 ft/ft.

- a = Increase in degree of curvature per 100' of spiral
- D = Degree of curvature
- e = Superelevation in ft. /ft.
- Lc = Normal crown runoff in feet
- Ls = Superelevation runoff in feet
- NC = Maintain normal crown
- RC = Remove adverse crown and superelevate to normal crown slope

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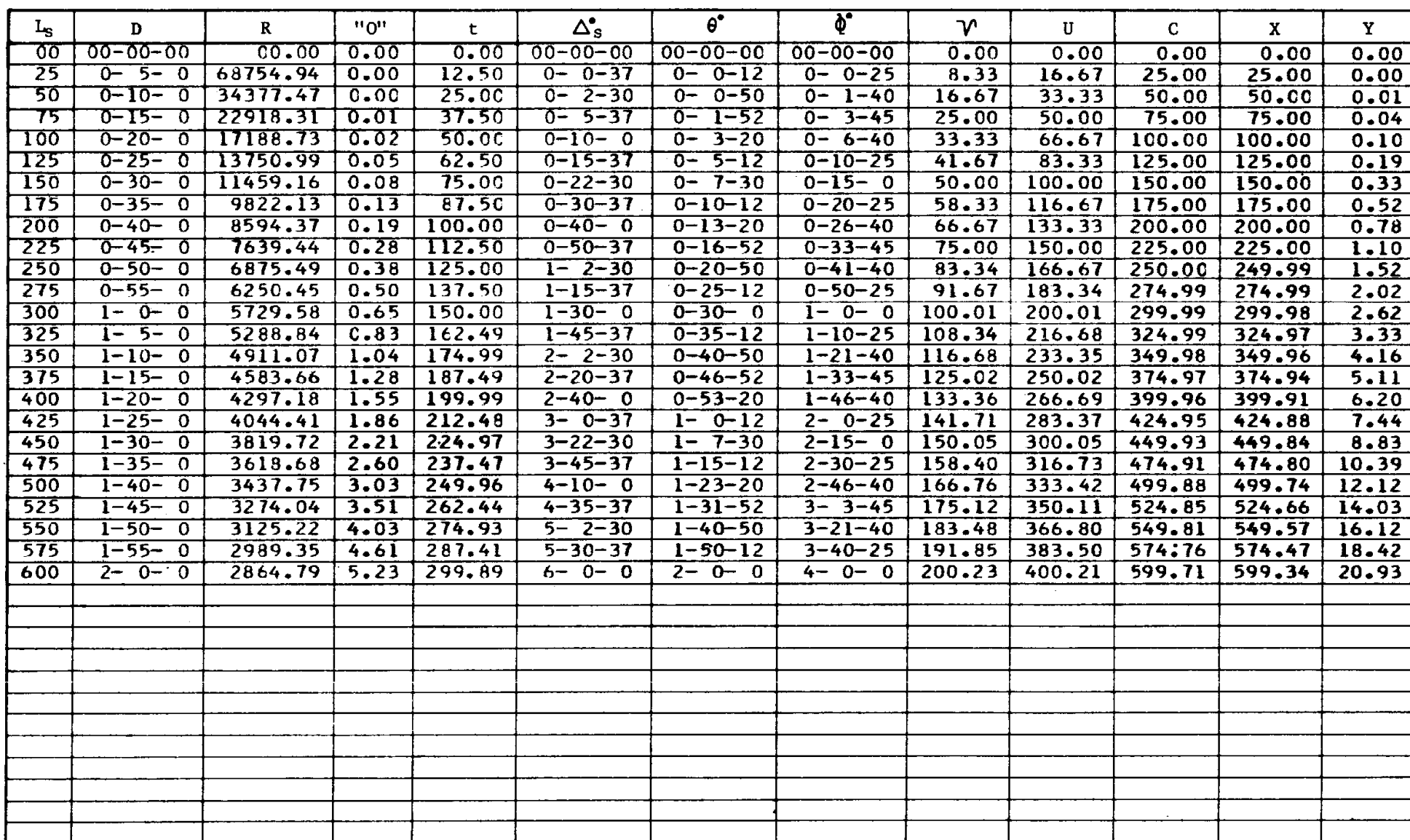


For superelevation distribution,
see Std. D-56.40.

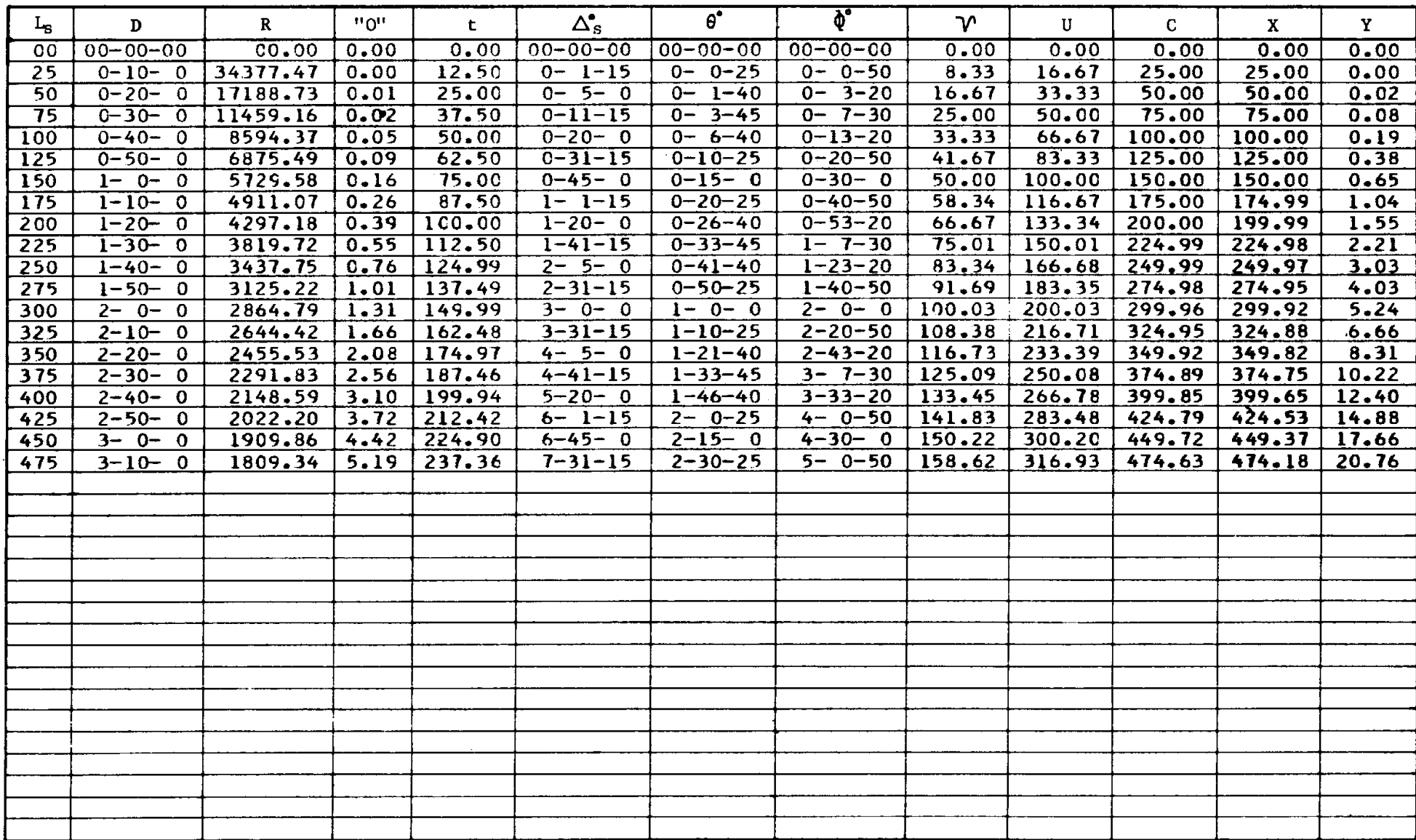


For superelevation distribution,
see Std. D-56.40.

DESIGN APPROVED <i>H. O'Leary</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS GUIDE	REV. DATE 1/32
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For superelevation distribution,
see Std. D-56.40.



For definitions of spiral values and their applicable formulae, see Std. D-55.10.

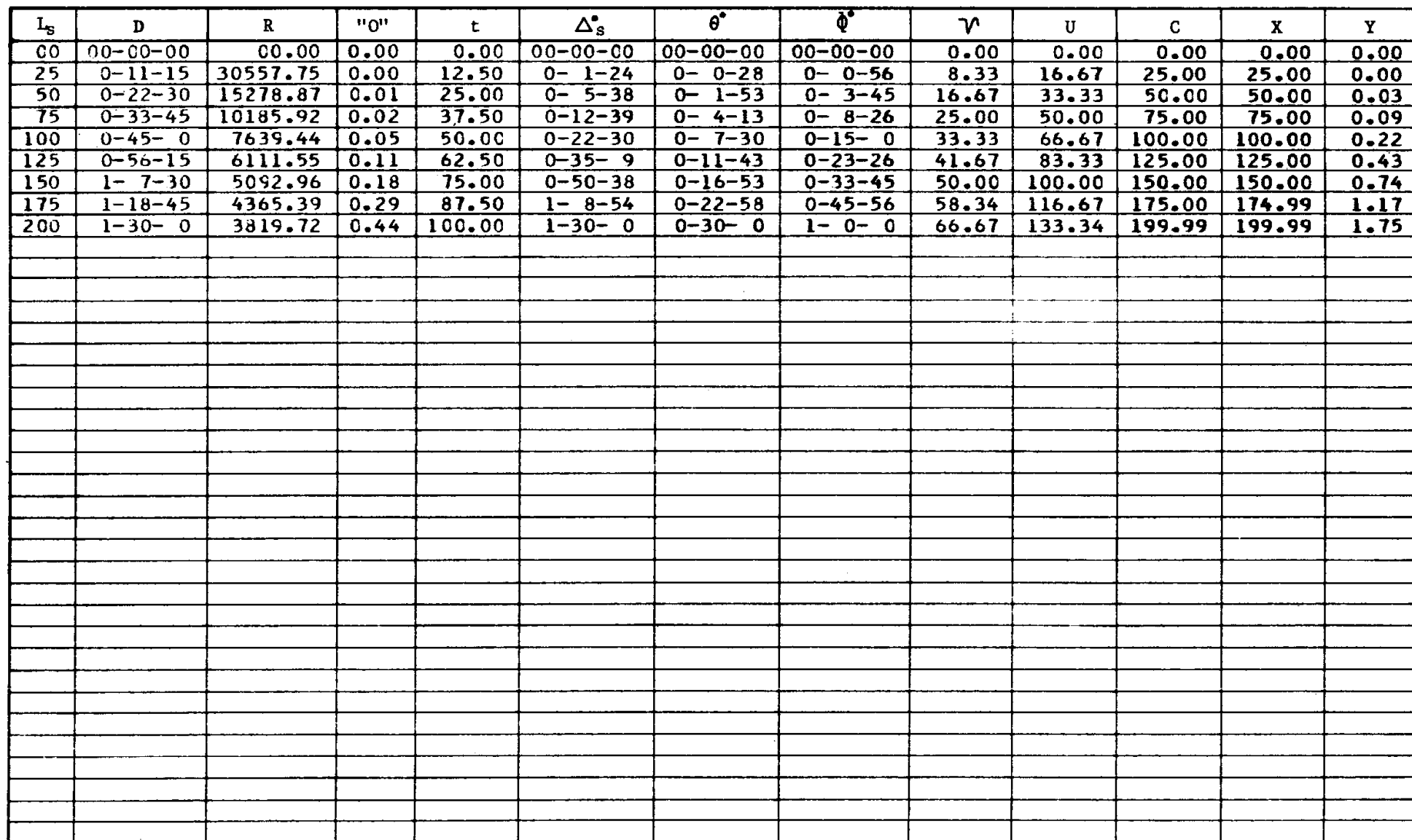
For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

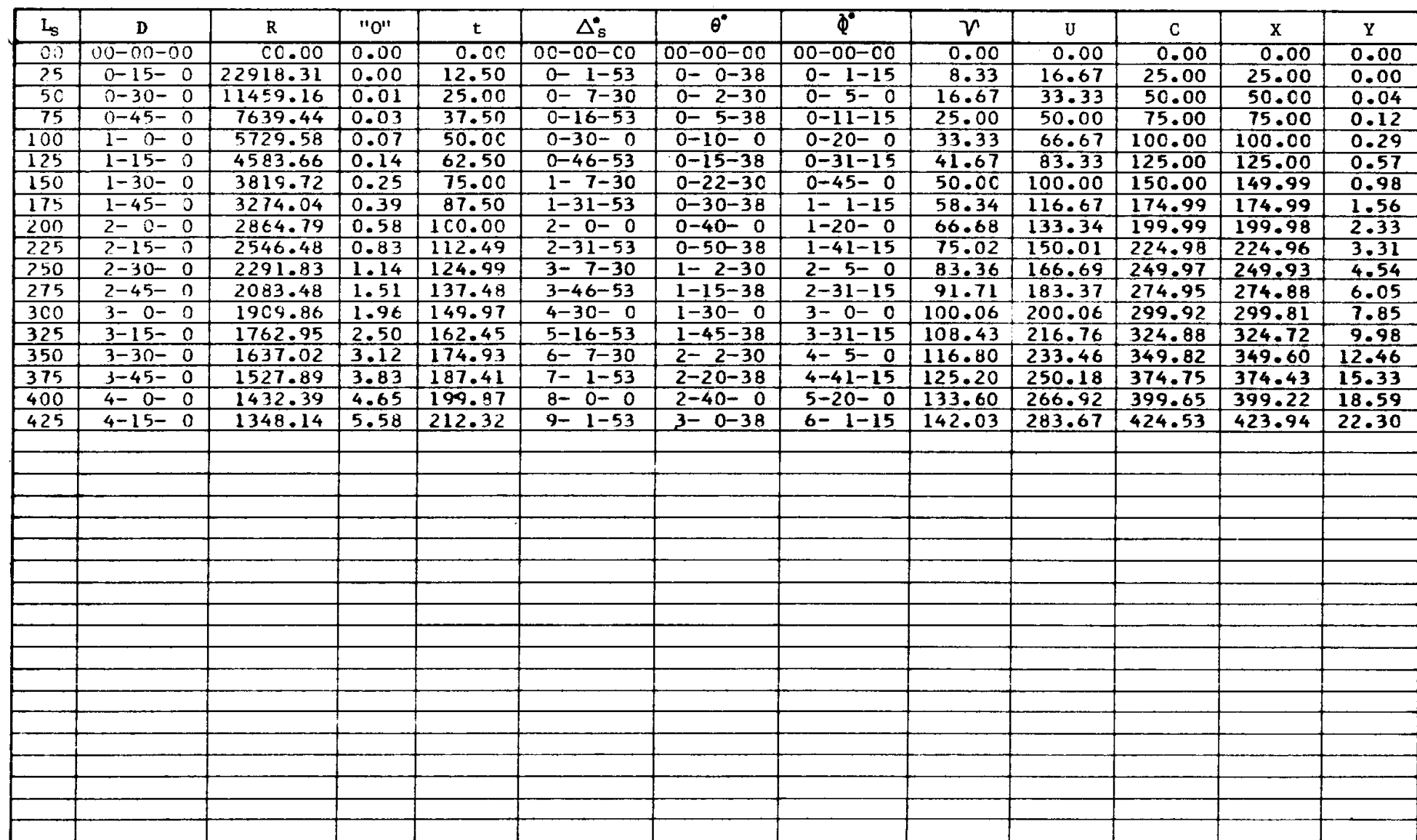
For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

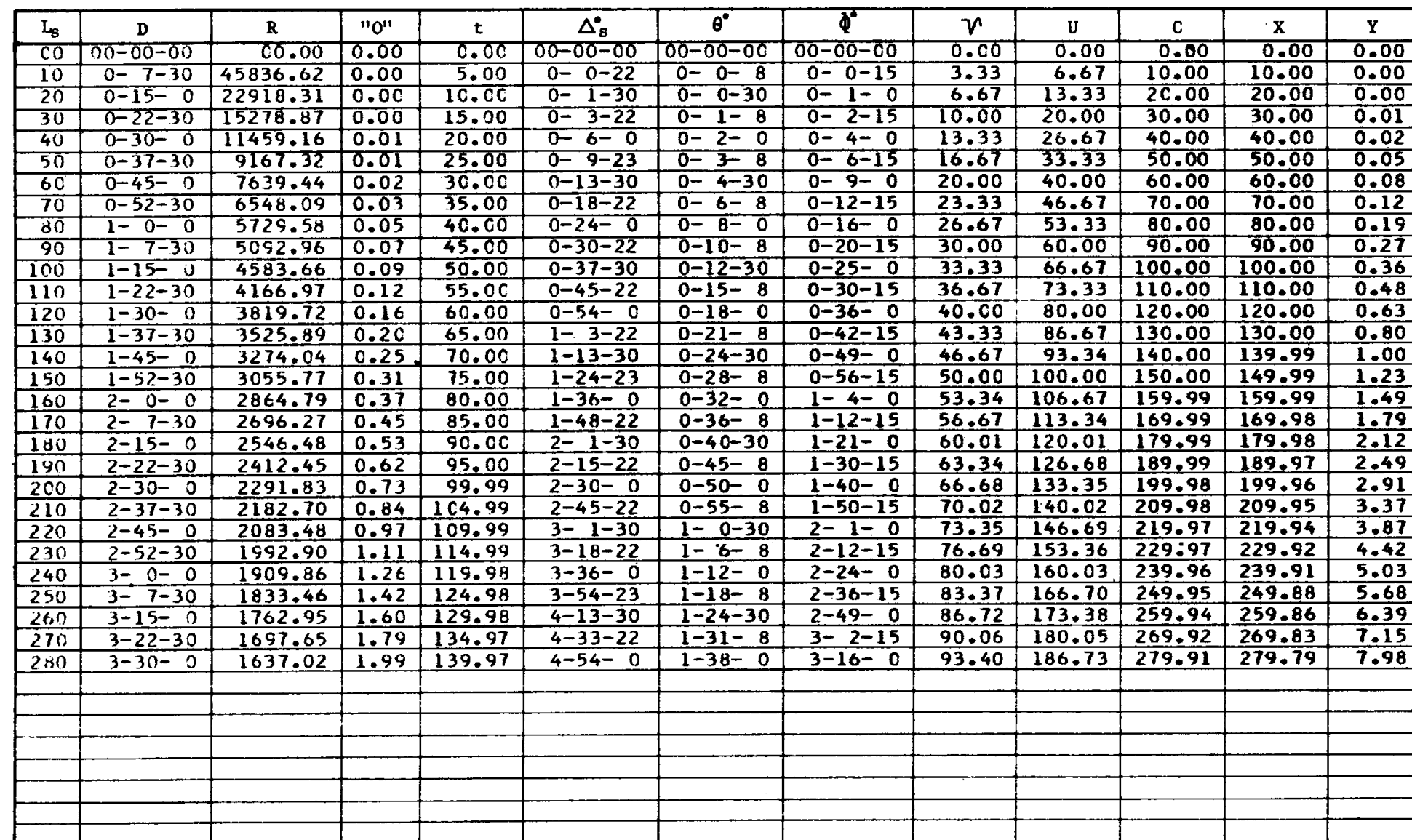


For superelevation distribution,
see Std. D-56.40.

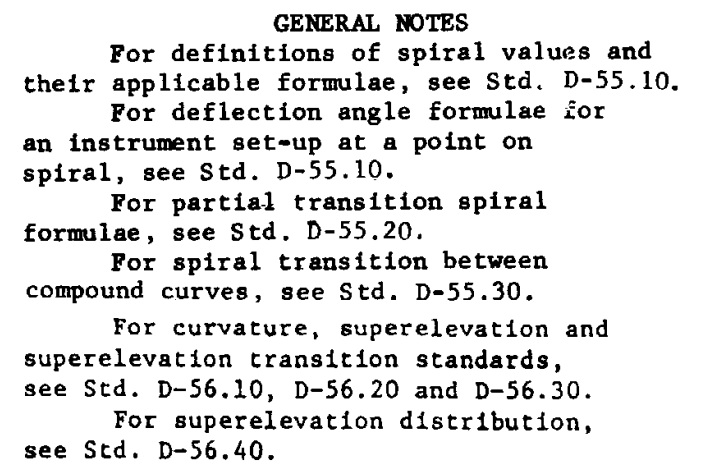
DESIGN APPROVED <i>[Signature]</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS GUIDE	REV DATE 1/82
APPROVED FOR DISTRIBUTION <i>[Signature]</i>	TRANSITION SPIRAL TABLE FOR $a=3/4$	PLAN NO. D-57.20



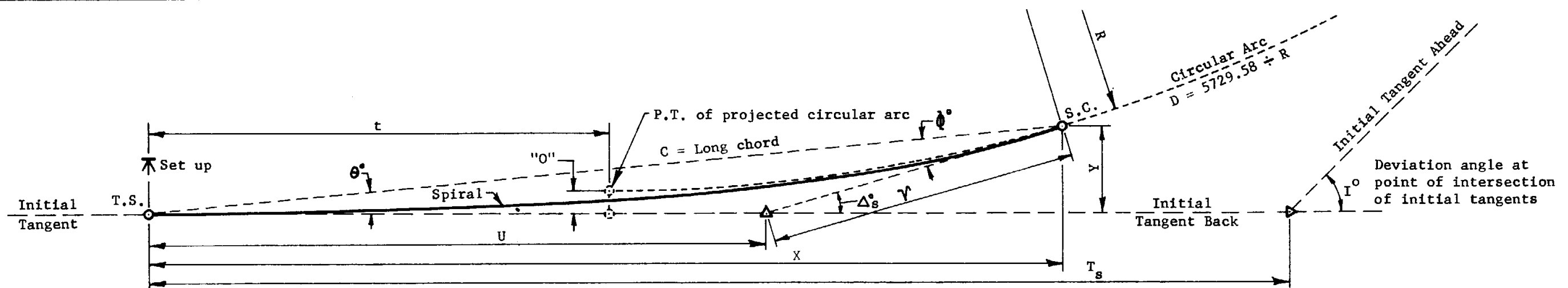
For superelevation distribution,
see Std. D-56.40.



For superelevation distribution,
see Std. D-56.40.



DESIGN APPROVED <i>[Signature]</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS DIVISION	REV. DATE 1/82
APPROVED FOR DISTRIBUTION <i>[Signature]</i>	TRANSITION SPIRAL TABLE FOR a=1-1/3	PLAN NO. D-57.27



L_s	D	R	"O"	t	Δ_s	θ°	ϕ°	γ	U	C	X	Y
00	00-00-00	00.00	0.00	0.00	00-00-00	00-00-00	00-00-00	0.00	0.00	0.00	0.00	0.00
10	0-10-0	34377.48	0.00	5.00	0-0-30	0-0-10	0-0-20	3.33	6.67	10.00	10.00	0.00
20	0-20-0	17188.74	0.00	10.00	0-2-0	0-0-40	0-1-20	6.67	13.33	20.00	20.00	0.00
30	0-30-0	11459.16	0.00	15.00	0-4-30	0-1-30	0-3-0	10.00	20.00	30.00	30.00	0.01
40	0-40-0	8594.37	0.01	20.00	0-8-0	0-2-40	0-5-20	13.33	26.67	40.00	40.00	0.03
50	0-50-0	6875.50	0.02	25.00	0-12-30	0-4-10	0-8-20	16.67	33.33	50.00	50.00	0.06
60	1-0-0	5729.58	0.03	30.00	0-18-0	0-6-0	0-12-0	20.00	40.00	60.00	60.00	0.10
70	1-10-0	4911.07	0.04	35.00	0-24-30	0-8-10	0-16-20	23.33	46.67	70.00	70.00	0.17
80	1-20-0	4297.19	0.06	40.00	0-32-0	0-10-40	0-21-20	26.67	53.33	80.00	80.00	0.25
90	1-30-0	3819.72	0.09	45.00	0-40-30	0-13-30	0-27-0	30.00	60.00	90.00	90.00	0.35
100	1-40-0	3437.75	0.12	50.00	0-50-0	0-16-40	0-33-20	33.33	66.67	100.00	100.00	0.48
110	1-50-0	3125.23	0.16	55.00	1-0-30	0-20-10	0-40-20	36.67	73.33	110.00	110.00	0.65
120	2-0-0	2864.79	0.21	60.00	1-12-0	0-24-0	0-48-0	40.00	80.00	120.00	119.99	0.84
130	2-10-0	2644.42	0.27	65.00	1-24-30	0-28-10	0-56-20	43.33	86.67	130.00	129.99	1.07
140	2-20-0	2455.53	0.33	70.00	1-38-0	0-32-40	1-5-20	46.67	93.33	139.99	139.99	1.33
150	2-30-0	2291.83	0.41	75.00	1-52-30	0-37-30	1-15-0	50.00	100.00	149.99	149.98	1.64
160	2-40-0	2148.59	0.50	80.00	2-8-0	0-42-40	1-25-20	53.33	106.67	159.99	159.98	1.99
170	2-50-0	2022.20	0.60	84.99	2-24-30	0-48-10	1-36-20	56.67	113.33	169.99	169.97	2.38
180	3-0-0	1909.86	0.71	89.99	2-42-0	0-54-0	1-48-0	60.00	120.00	179.98	179.96	2.83
190	3-10-0	1809.34	0.83	94.99	3-0-30	1-0-10	2-0-20	63.33	126.67	189.98	189.95	3.32
200	3-20-0	1718.87	0.97	99.99	3-20-0	1-6-40	2-13-20	66.67	133.33	199.97	199.93	3.88
210	3-30-0	1637.02	1.12	104.99	3-40-30	1-13-30	2-27-0	70.00	140.00	209.96	209.91	4.49
220	3-40-0	1562.61	1.29	109.98	4-2-0	1-20-40	2-41-20	73.33	146.67	219.95	219.89	5.16
230	3-50-0	1494.67	1.47	114.98	4-24-30	1-28-10	2-56-20	76.67	153.33	229.94	229.86	5.90
240	4-0-0	1432.40	1.68	119.97	4-48-0	1-36-0	3-12-0	80.00	160.00	239.92	239.83	6.70
250	4-10-0	1375.10	1.89	124.97	5-12-30	1-44-10	3-28-20	83.33	166.67	249.91	249.79	7.57
260	4-20-0	1322.21	2.13	129.96	5-38-0	1-52-40	3-45-20	86.67	173.33	259.89	259.75	8.52
270	4-30-0	1273.24	2.38	134.95	6-4-30	2-1-30	4-3-0	90.00	180.00	269.86	269.70	9.54
280	4-40-0	1227.77	2.66	139.94	6-32-0	2-10-40	4-21-20	93.33	186.67	279.84	279.64	10.63
290	4-50-0	1185.43	2.96	144.93	7-0-30	2-20-10	4-40-20	96.67	193.33	289.81	289.57	11.81
300	5-0-0	1145.92	3.27	149.91	7-30-0	2-30-0	5-0-0	100.00	200.00	299.77	299.49	13.08
310	5-10-0	1108.95	3.61	154.90	8-0-30	2-40-10	5-20-20	103.33	206.67	309.73	309.39	14.43
320	5-20-0	1074.30	3.97	159.88	8-32-0	2-50-40	5-41-20	106.67	213.33	319.68	319.29	15.86
330	5-30-0	1041.74	4.35	164.86	9-4-30	3-1-30	6-3-0	110.00	220.00	329.63	329.17	17.40
340	5-40-0	1011.10	4.76	169.84	9-38-0	3-12-40	6-25-20	113.33	226.67	339.57	339.04	19.02
350	5-50-0	982.21	5.20	174.81	10-12-30	3-24-10	6-48-20	117.00	233.33	349.50	348.89	20.74
360	6-0-0	954.93	5.65	179.79	10-48-0	3-36-0	7-12-0	120.00	240.00	359.43	358.72	22.57

GENERAL NOTES

For definitions of spiral values and their applicable formulae, see Std. D-55.10.

For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

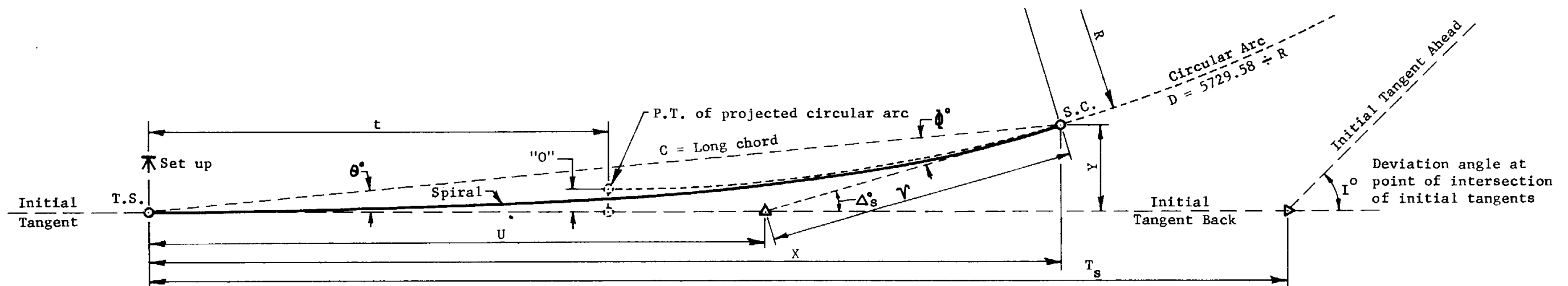
For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

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APPROVED FOR DISTRIBUTION <i>[Signature]</i>	SPIRAL TRANSITION TABLE FOR $a=1-2/3$	PLAN NO. D-57.32



I_s	D	R	"O"	t	Δ_s	θ°	ϕ°	γ	U	C	X	Y
00	00-00-00	00.00	0.00	0.00	00-00-00	00-00-00	00-00-00	0.00	0.00	0.00	0.00	0.00
10	0-15-0	22918.31	0.00	5.00	0-0-45	0-0-15	0-0-30	3.33	6.67	10.00	10.00	0.00
20	0-30-0	11459.16	0.00	10.00	0-3-0	0-1-0	0-2-0	6.67	13.33	20.00	20.00	0.01
30	0-45-0	7639.44	0.00	15.00	0-6-45	0-2-15	0-4-30	10.00	20.00	30.00	30.00	0.02
40	1-0-0	5729.58	0.01	20.00	0-12-0	0-4-0	0-8-0	13.33	26.67	40.00	40.00	0.05
50	1-15-0	4583.66	0.02	25.00	0-18-45	0-6-15	0-12-30	16.67	33.33	50.00	50.00	0.09
60	1-30-0	3819.72	0.04	30.00	0-27-0	0-9-0	0-18-0	20.00	40.00	60.00	60.00	0.16
70	1-45-0	3274.04	0.06	35.00	0-36-45	0-12-15	0-24-30	23.33	46.67	70.00	70.00	0.25
80	2-0-0	2864.79	0.09	40.00	0-48-0	0-16-0	0-32-0	26.67	53.33	80.00	80.00	0.37
90	2-15-0	2546.48	0.13	45.00	1-0-45	0-20-15	0-40-30	30.00	60.00	90.00	90.00	0.53
100	2-30-0	2291.83	0.18	50.00	1-15-0	0-25-0	0-50-0	33.33	66.67	100.00	100.00	0.73
110	2-45-0	2083.48	0.24	55.00	1-30-45	0-30-15	1-0-30	36.67	73.34	110.00	109.99	0.97
120	3-0-0	1909.86	0.31	60.00	1-48-0	0-36-0	1-12-0	40.00	80.00	119.99	119.99	1.26
130	3-15-0	1762.95	0.40	65.00	2-6-45	0-42-15	1-24-30	43.34	86.67	129.99	129.98	1.60
140	3-30-0	1637.02	0.50	70.00	2-27-0	0-49-0	1-38-0	46.68	93.34	139.99	139.97	2.00
150	3-45-0	1527.89	0.61	74.99	2-48-45	0-56-15	1-52-30	50.01	100.01	149.98	149.96	2.45
160	4-0-0	1432.39	0.74	79.99	3-12-0	1-4-0	2-8-0	53.35	106.68	159.98	159.95	2.98
170	4-15-0	1348.14	0.89	84.99	3-36-45	1-12-15	2-24-30	56.69	113.35	169.97	169.93	3.57
180	4-30-0	1273.24	1.06	89.99	4-3-0	1-21-0	2-42-0	60.03	120.03	179.96	179.91	4.24
190	4-45-0	1206.23	1.25	94.98	4-30-45	1-30-15	3-0-30	63.37	126.70	189.95	189.88	4.99
200	5-0-0	1145.92	1.45	99.97	5-0-0	1-40-0	3-20-0	66.72	133.38	199.93	199.85	5.81
210	5-15-0	1091.35	1.68	104.97	5-30-45	1-50-15	3-40-30	70.07	140.06	209.91	209.81	6.73
220	5-30-0	1041.74	1.94	109.96	6-3-0	2-1-0	4-2-0	73.42	146.75	219.89	219.75	7.74
230	5-45-0	996.45	2.21	114.95	6-36-45	2-12-15	4-24-30	76.77	153.43	229.86	229.69	8.84
240	6-0-0	954.93	2.51	119.94	7-12-0	2-24-0	4-48-0	80.13	160.12	239.83	239.62	10.04
250	6-15-0	916.73	2.84	124.92	7-48-45	2-36-15	5-12-30	83.49	166.82	249.79	249.53	11.35
260	6-30-0	881.47	3.19	129.91	8-27-0	2-49-0	5-38-0	86.86	173.51	259.75	259.43	12.76
270	6-45-0	848.83	3.58	134.89	9-6-45	3-2-15	6-4-30	90.24	180.22	269.70	269.32	14.29
280	7-0-0	818.51	3.99	139.86	9-48-0	3-16-0	6-32-0	93.62	186.93	279.63	279.18	15.93
290	7-15-0	790.29	4.43	144.84	10-30-45	3-30-15	7-0-30	97.00	193.65	289.56	289.02	17.70
300	7-30-0	763.94	4.91	149.81	11-15-0	3-45-0	7-30-0	100.40	200.37	299.48	298.84	19.59
310	7-45-0	739.30	5.41	154.77	12-0-45	4-0-15	8-0-30	103.81	207.10	309.39	308.64	21.60
320	8-0-0	716.20	5.96	159.73	12-48-0	4-16-0	8-32-0	107.22	213.85	319.29	318.40	23.75
330	8-15-0	694.49	6.53	164.69	13-36-45	4-32-15	9-4-30	110.65	220.60	329.17	328.14	26.04
340	8-30-0	674.07	7.14	169.64	14-27-0	4-49-0	9-38-0	114.08	227.36	339.03	337.84	28.47
350	8-45-0	654.81	7.79	174.58	15-18-45	5-6-15	10-12-30	117.54	234.14	348.88	347.50	31.04
360	9-0-0	636.62	8.48	179.52	16-12-0	5-24-0	10-48-0	121.00	240.93	358.72	357.12	33.76

GENERAL NOTES

For definitions of spiral values and their applicable formulae, see Std. D-55.10.

For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

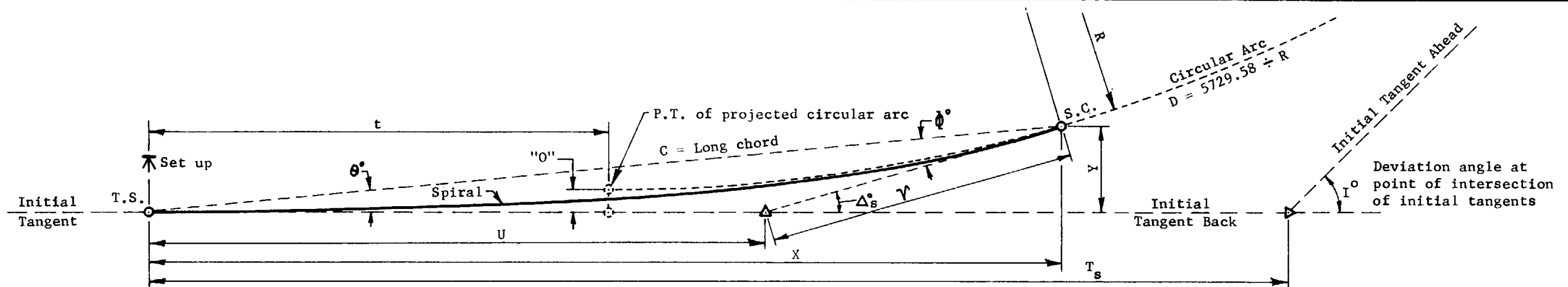
For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

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L_s	D	R	"O"	t	Δ_s	θ	ϕ	γ	U	C	X	Y
00	00-00-00	00.00	0.00	0.00	00-00-00	00-00-00	00-00-00	0.00	0.00	0.00	0.00	0.00
10	0-20-0	17188.74	0.00	5.00	0-1-0	0-0-20	0-0-40	3.33	6.67	10.00	10.00	0.00
20	0-40-0	8594.37	0.00	10.00	0-4-0	0-1-20	0-2-40	6.67	13.33	20.00	20.00	0.01
30	1-0-0	5729.58	0.01	15.00	0-9-0	0-3-0	0-6-0	10.00	20.00	30.00	30.00	0.03
40	1-20-0	4297.18	0.02	20.00	0-16-0	0-5-20	0-10-40	13.33	26.67	40.00	40.00	0.06
50	1-40-0	3437.75	0.03	25.00	0-25-0	0-8-20	0-16-40	16.67	33.33	50.00	50.00	0.12
60	2-0-0	2864.79	0.05	30.00	0-36-0	0-12-0	0-24-0	20.00	40.00	60.00	60.00	0.21
70	2-20-0	2455.53	0.08	35.00	0-49-0	0-16-20	0-32-40	23.33	46.67	70.00	70.00	0.33
80	2-40-0	2148.59	0.12	40.00	1-4-0	0-21-20	0-42-40	26.67	53.33	80.00	80.00	0.50
90	3-0-0	1909.86	0.18	45.00	1-21-0	0-27-0	0-54-0	30.00	60.00	90.00	89.99	0.71
100	3-20-0	1718.87	0.24	50.00	1-40-0	0-33-20	1-6-40	33.34	66.67	100.00	99.99	0.97
110	3-40-0	1562.61	0.32	55.00	2-1-0	0-40-20	1-20-40	36.67	73.34	109.99	109.99	1.29
120	4-0-0	1432.39	0.42	60.00	2-24-0	0-48-0	1-36-0	40.01	80.01	119.99	119.98	1.68
130	4-20-0	1322.21	0.53	64.99	2-49-0	0-56-20	1-52-40	43.34	86.68	129.99	129.97	2.13
140	4-40-0	1227.77	0.66	69.99	3-16-0	1-5-20	2-10-40	46.68	93.35	139.98	139.95	2.66
150	5-0-0	1145.92	0.82	74.99	3-45-0	1-15-0	2-30-0	50.02	100.02	149.97	149.94	3.27
160	5-20-0	1074.30	0.99	79.99	4-16-0	1-25-20	2-50-40	53.36	106.70	159.96	159.91	3.97
170	5-40-0	1011.10	1.19	84.98	4-49-0	1-36-20	3-12-40	56.71	113.37	169.95	169.88	4.76
180	6-0-0	954.93	1.41	89.97	5-24-0	1-48-0	3-36-0	60.06	120.05	179.93	179.84	5.65
190	6-20-0	904.67	1.66	94.97	6-1-0	2-0-20	4-0-40	63.41	126.73	189.91	189.79	6.65
200	6-40-0	859.44	1.94	99.95	6-40-0	2-13-20	4-26-40	66.76	133.42	199.88	199.73	7.75
210	7-0-0	818.51	2.24	104.94	7-21-0	2-27-0	4-54-0	70.12	140.11	209.85	209.65	8.97
220	7-20-0	781.31	2.58	109.93	8-4-0	2-41-20	5-22-40	73.48	146.81	219.81	219.56	10.31
230	7-40-0	747.34	2.95	114.91	8-49-0	2-56-20	5-52-40	76.85	153.51	229.76	229.45	11.78
240	8-0-0	716.20	3.35	119.89	9-36-0	3-12-0	6-24-0	80.23	160.22	239.70	239.33	13.38
250	8-20-0	687.55	3.79	124.86	10-25-0	3-28-20	6-56-40	83.62	166.93	249.63	249.17	15.12
260	8-40-0	661.11	4.26	129.83	11-16-0	3-45-20	7-30-40	87.01	173.66	259.55	258.99	17.00
270	9-0-0	636.62	4.77	134.80	12-9-0	4-3-0	8-6-0	90.42	180.39	269.46	268.79	19.03
280	9-20-0	613.88	5.32	139.76	13-4-0	4-21-20	8-42-40	93.84	187.13	279.35	278.54	21.22
290	9-40-0	592.72	5.91	144.71	14-1-0	4-40-20	9-20-40	97.27	193.89	289.23	288.26	23.56
300	10-0-0	572.96	6.54	149.66	15-0-0	5-0-0	10-0-0	100.71	200.66	299.08	297.94	26.07
310	10-20-0	554.48	7.22	154.60	16-1-0	5-20-20	10-40-40	104.18	207.45	308.92	307.58	28.74
320	10-40-0	537.15	7.94	159.53	17-4-0	5-41-20	11-22-40	107.65	214.25	318.73	317.16	31.59
330	11-0-0	520.87	8.71	164.45	18-9-0	6-3-0	12-6-0	111.15	221.07	328.52	326.69	34.62
340	11-20-0	505.55	9.52	169.36	19-16-0	6-25-20	12-50-40	114.67	227.91	338.28	336.16	37.84
350	11-40-0	491.11	10.39	174.26	20-25-0	6-48-20	13-36-40	118.22	234.77	348.02	345.56	41.24

GENERAL NOTES

For definitions of spiral values and their applicable formulae, see Std. D-55.10.

For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

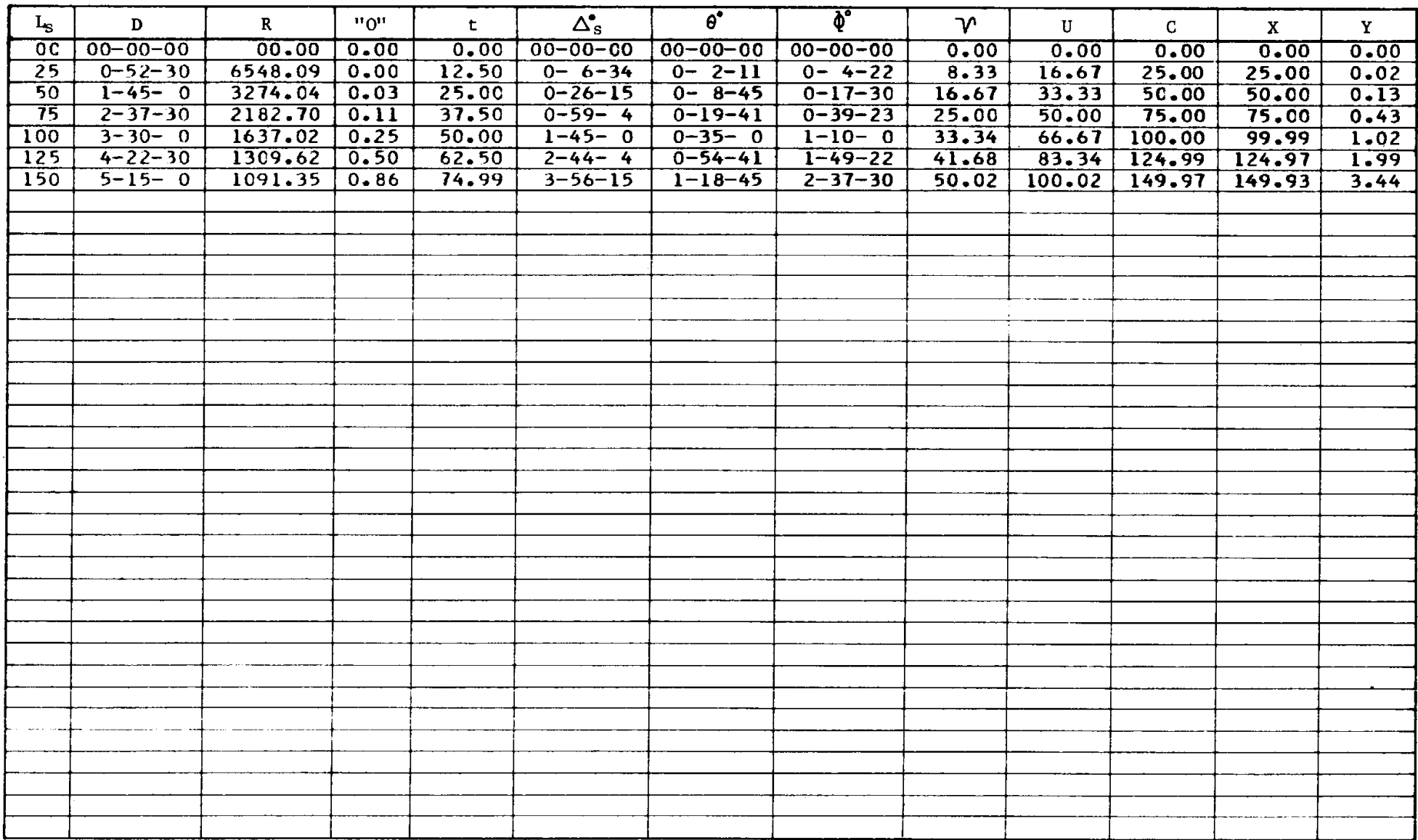
For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

DESIGN APPROVED <i>H. D. D.</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS GUIDE	REV. DATE 1/82
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For definitions of spiral values and their applicable formulae, see Std. D-55.10.

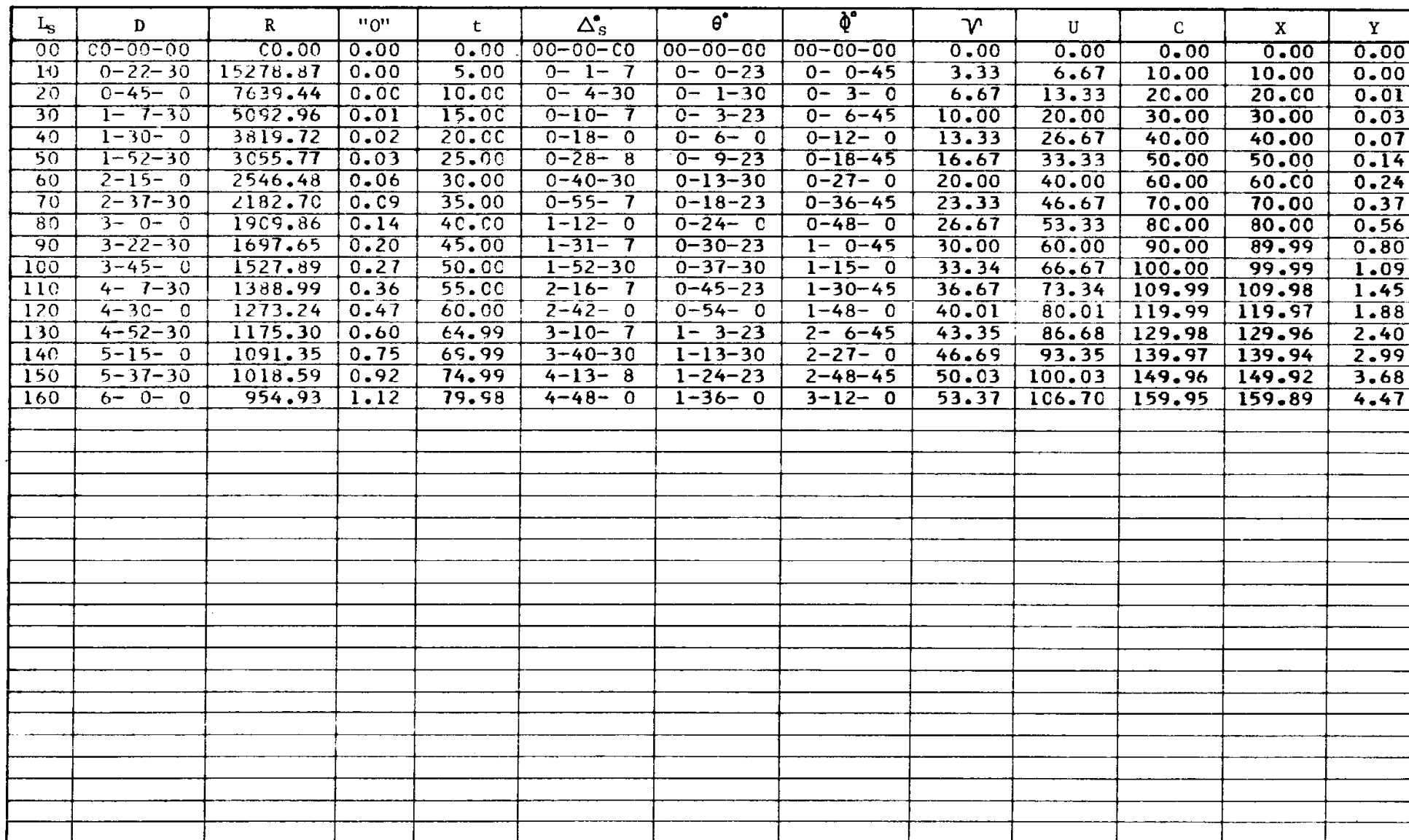
For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

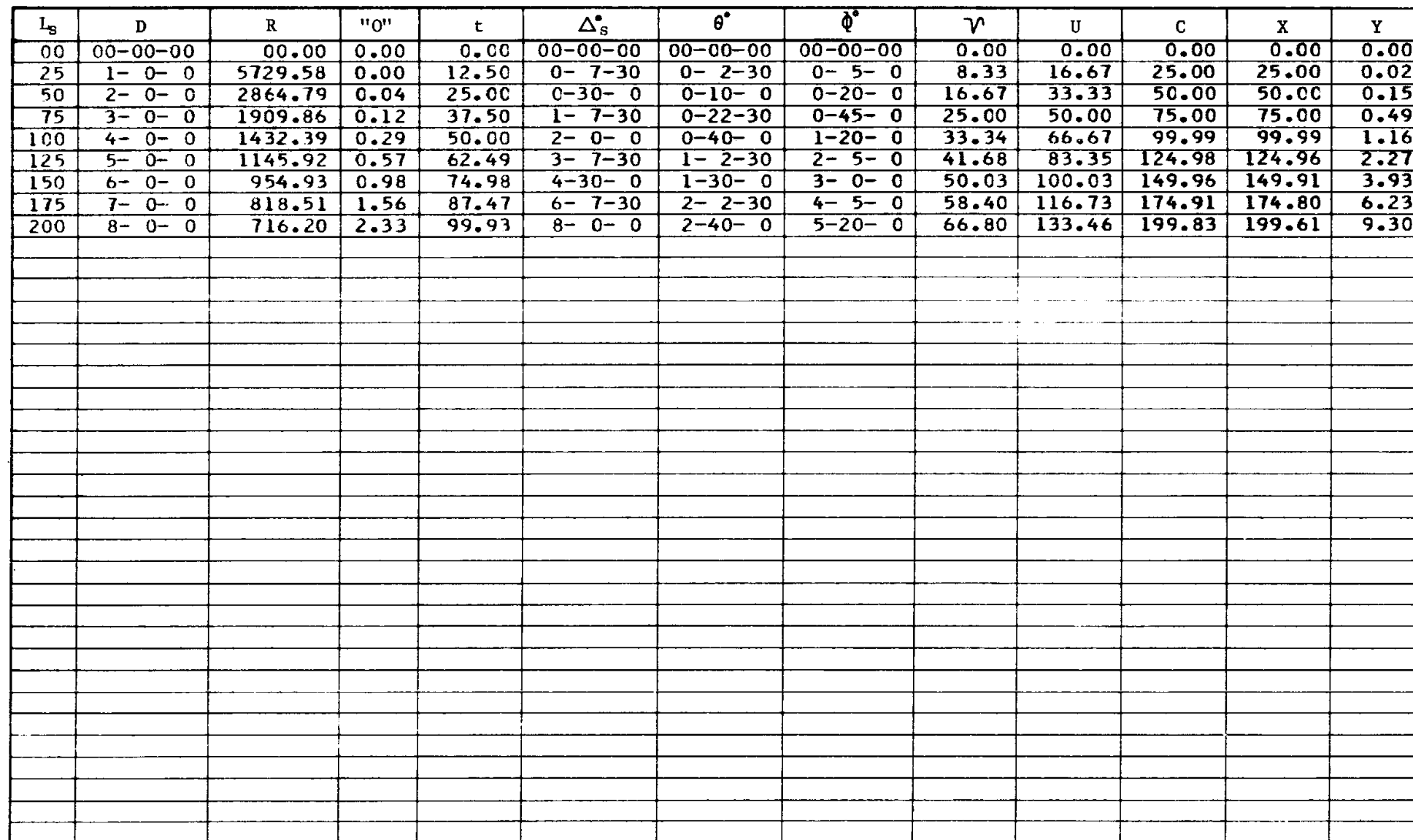
For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

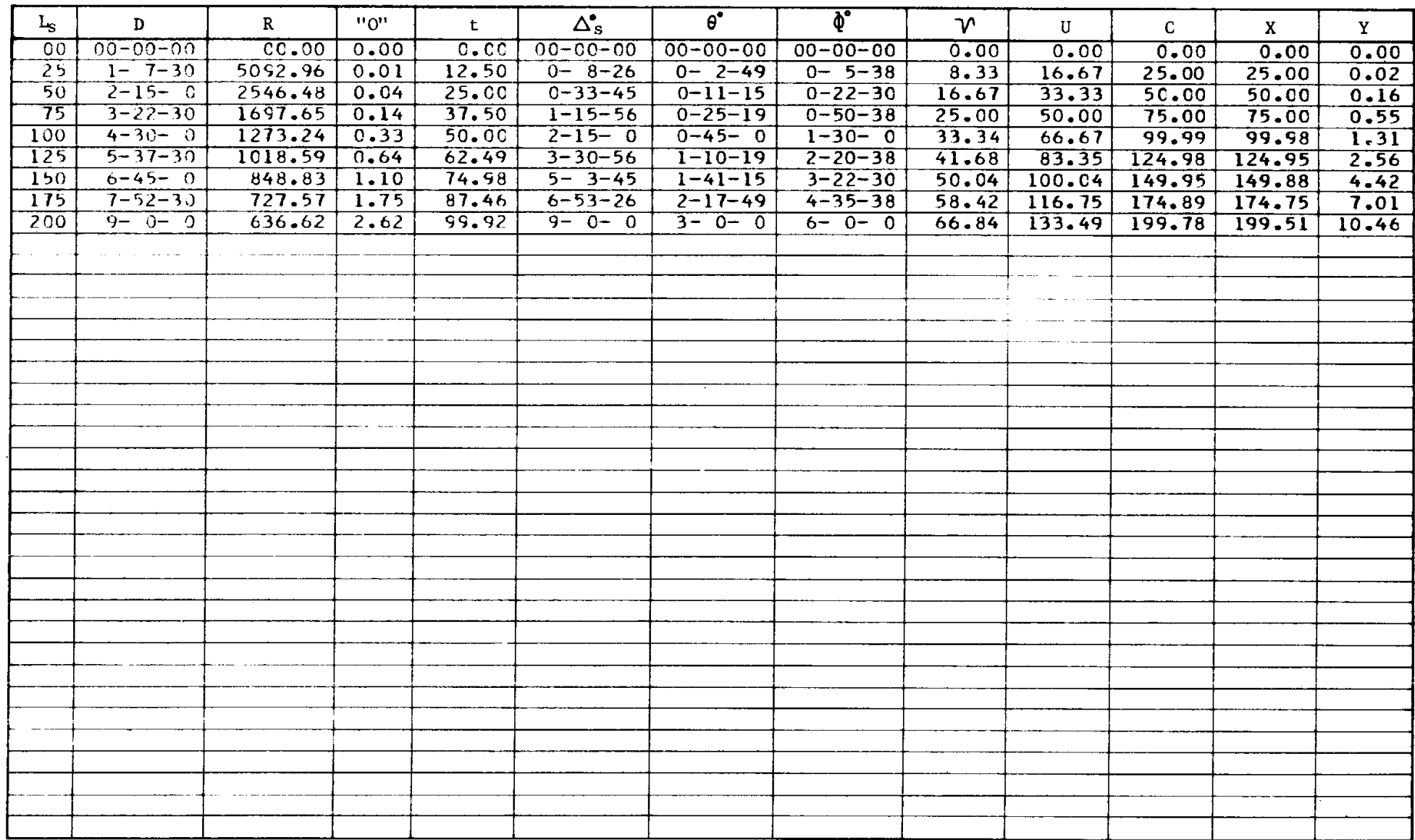


For superelevation distribution,
see Std. D-56.40.

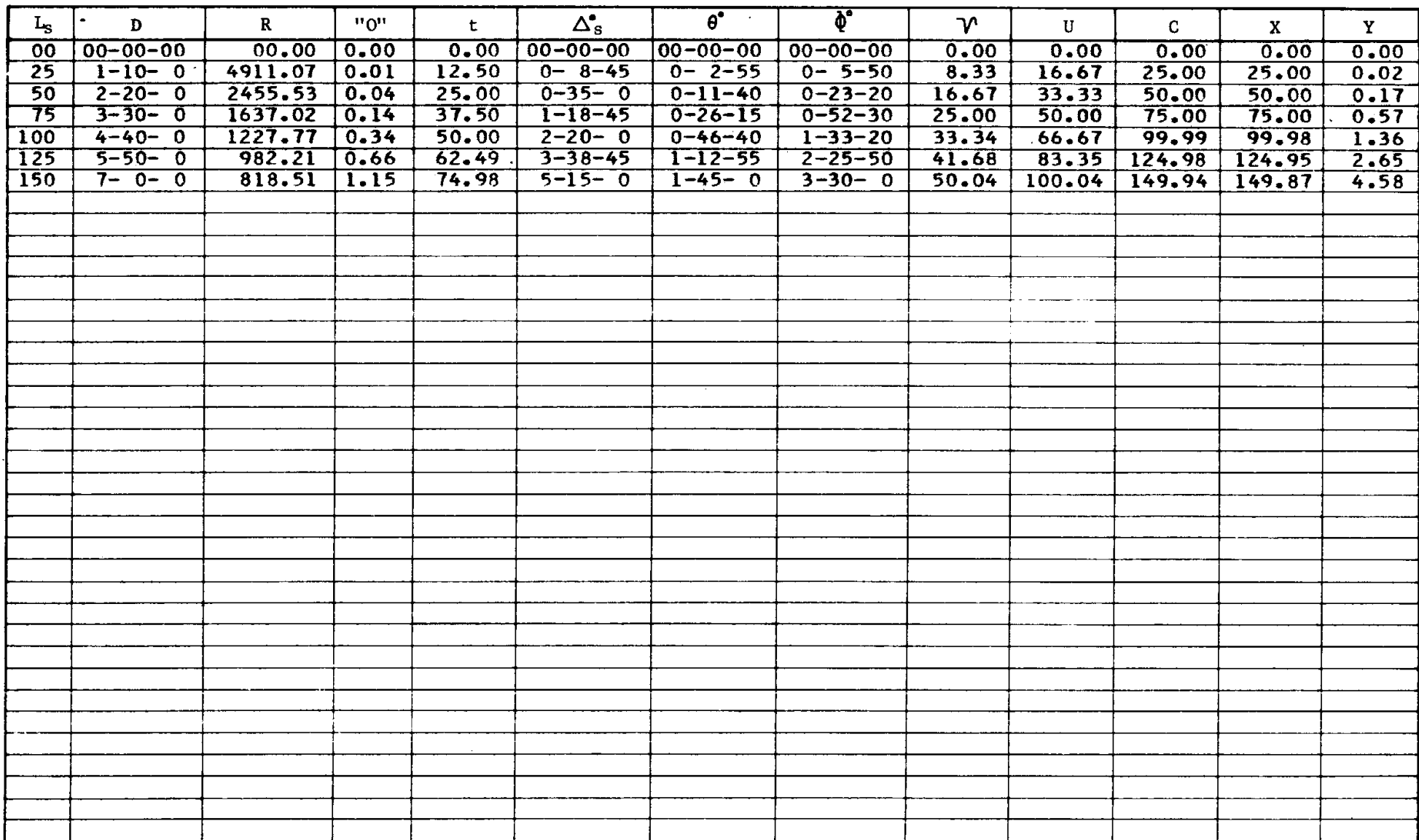
DESIGN APPROVED <i>P. E. Bay</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS GUIDE	REV DATE 1/82
APPROVED FOR DISTRIBUTION <i>W. H. [Signature]</i>	TRANSITION SPIRAL TABLE FOR $a=3-3/4$	PLAN NO. D-57.50



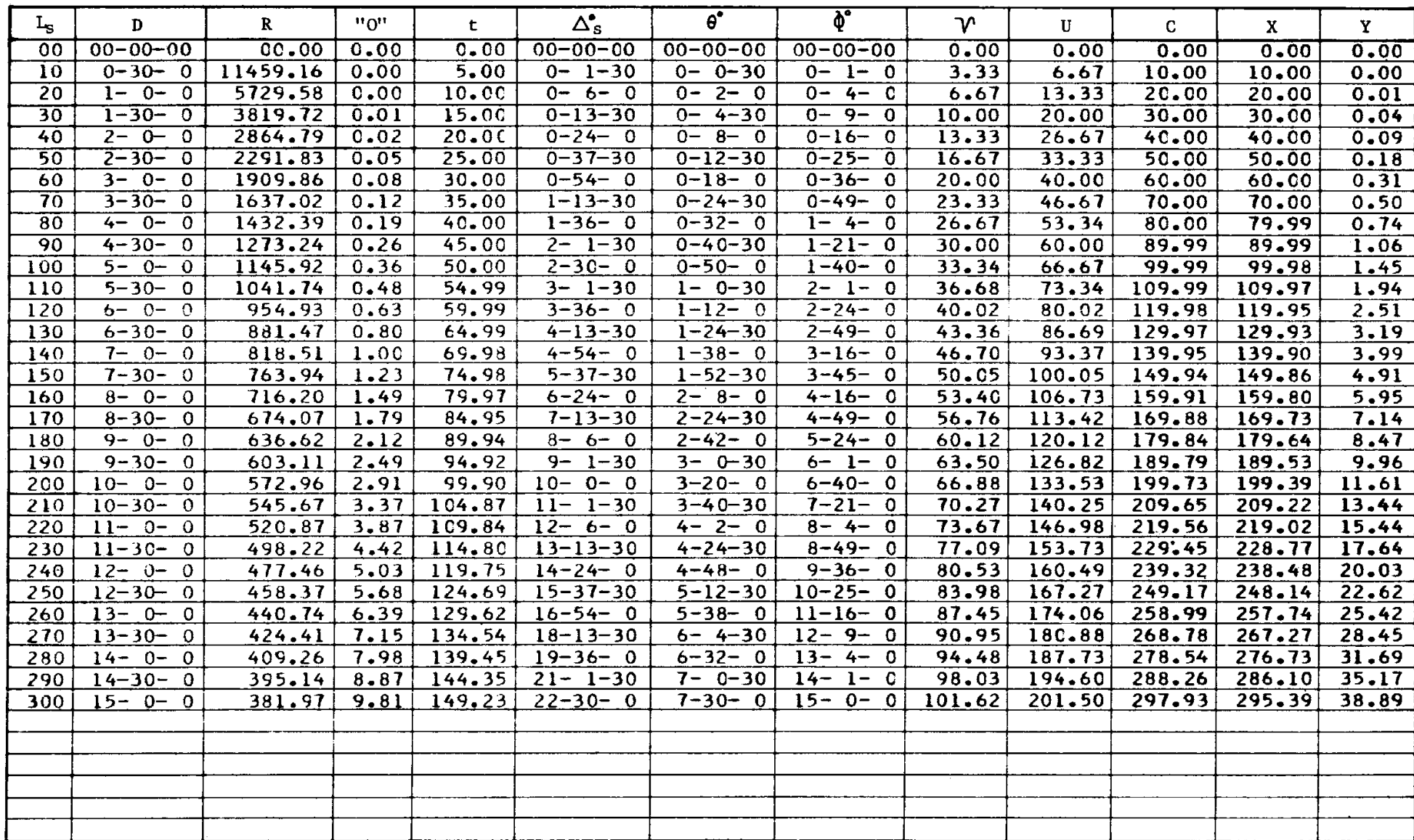
For superelevation distribution,
see Std. D-56.40.



For superelevation distribution,
see Std. D-56.40.



For superelevation distribution,
see Std. D-56.40.



For definitions of spiral values and their applicable formulae, see Std. D-55.10.

For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

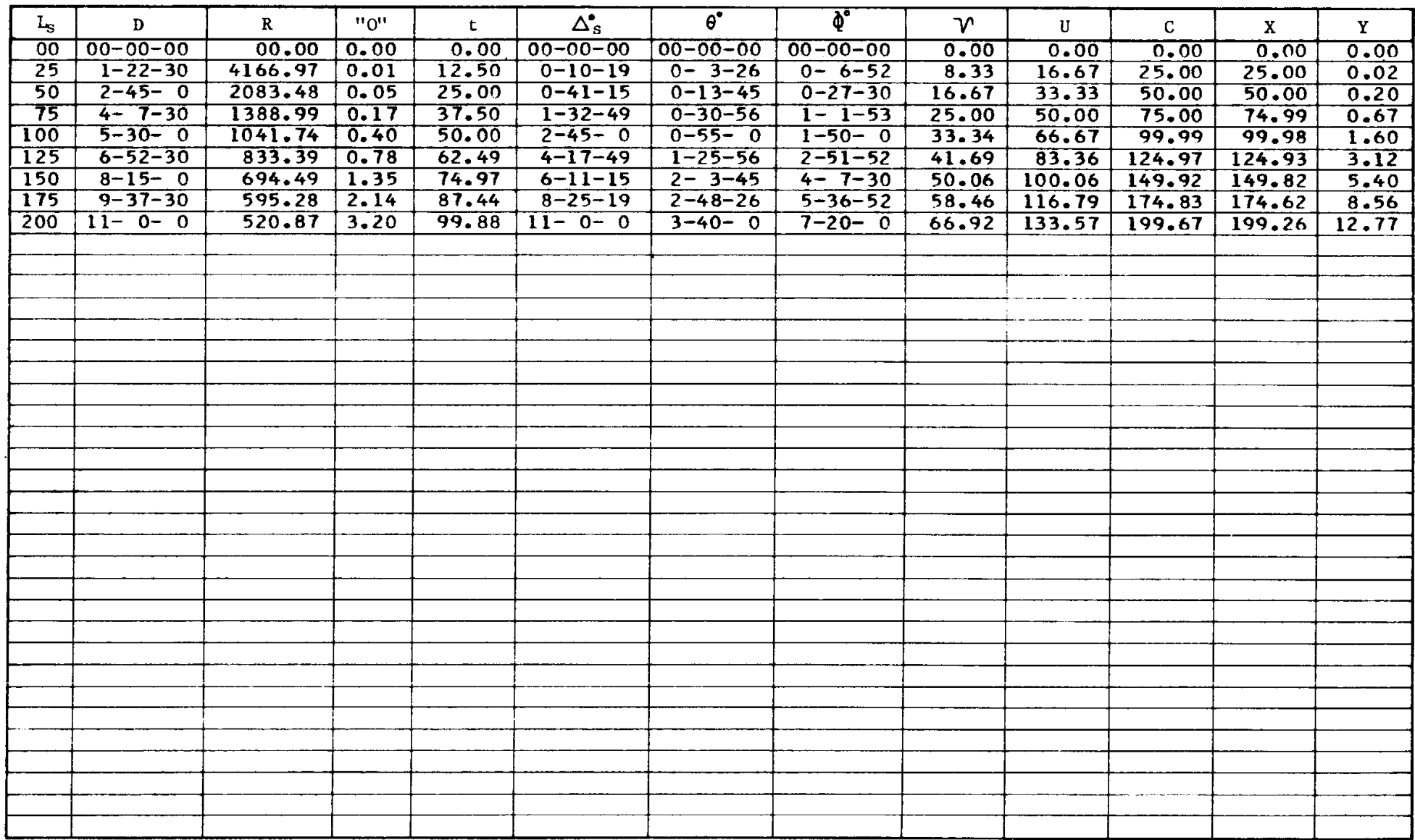
For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

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For definitions of spiral values and their applicable formulae, see Std. D-55.10.

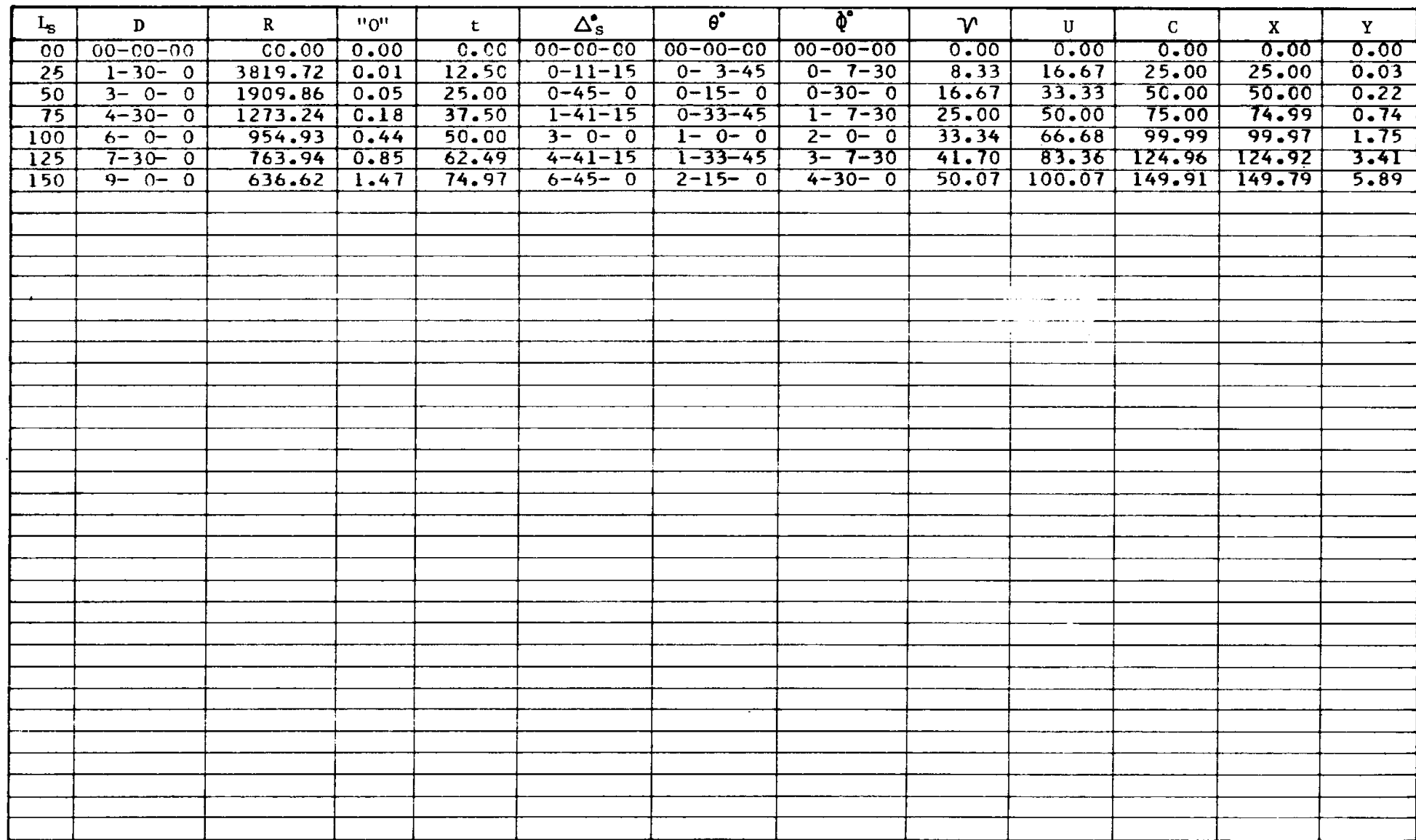
For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

For partial transition spiral formulae, see Std. D-55.20.

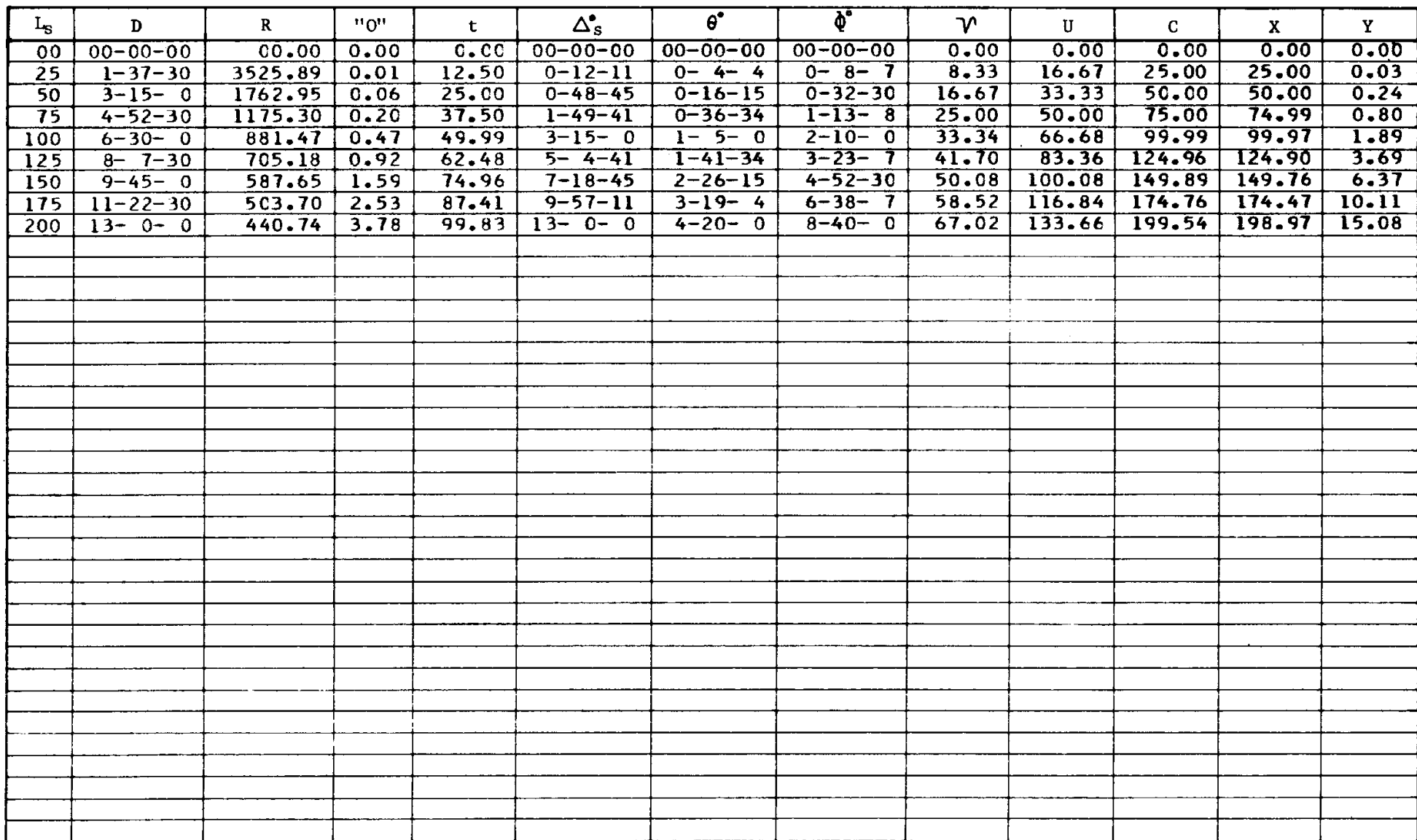
For spiral transition between compound curves, see Std. D-55.30.

For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

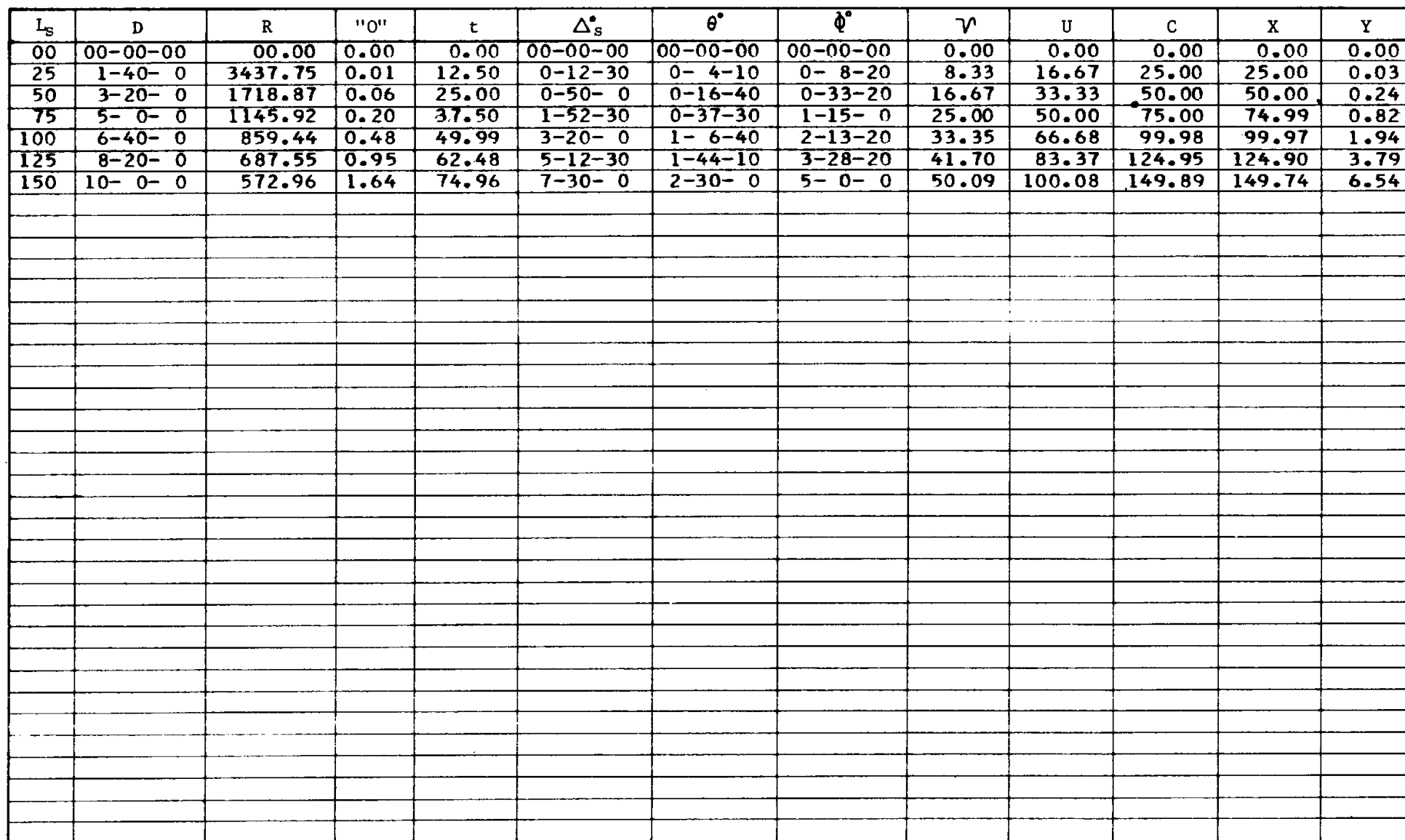
For superelevation distribution, see Std. D-56.40.



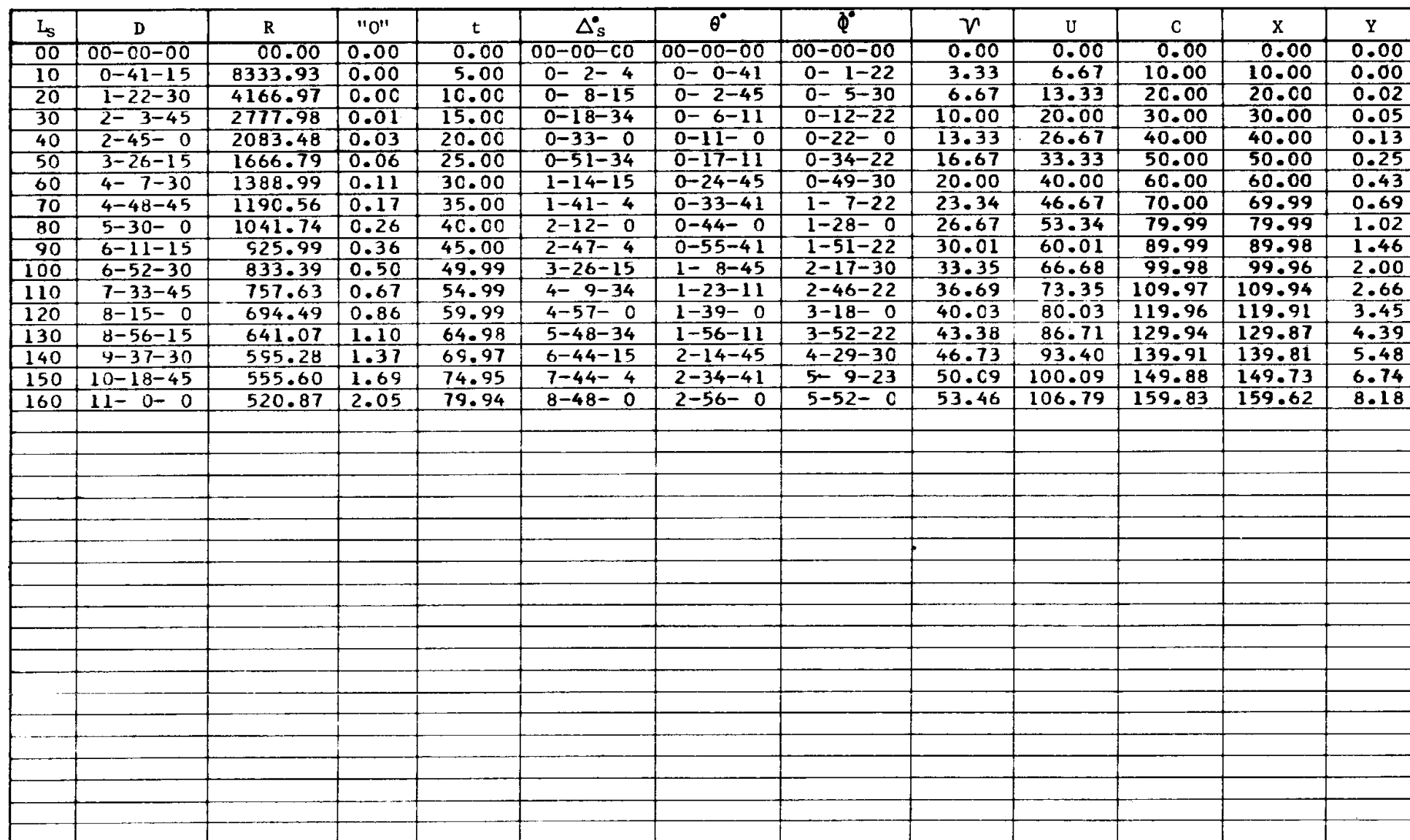
DESIGN APPROVED <i>J. D. [Signature]</i>	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION PLANS GUIDE	REV. DATE 1/62
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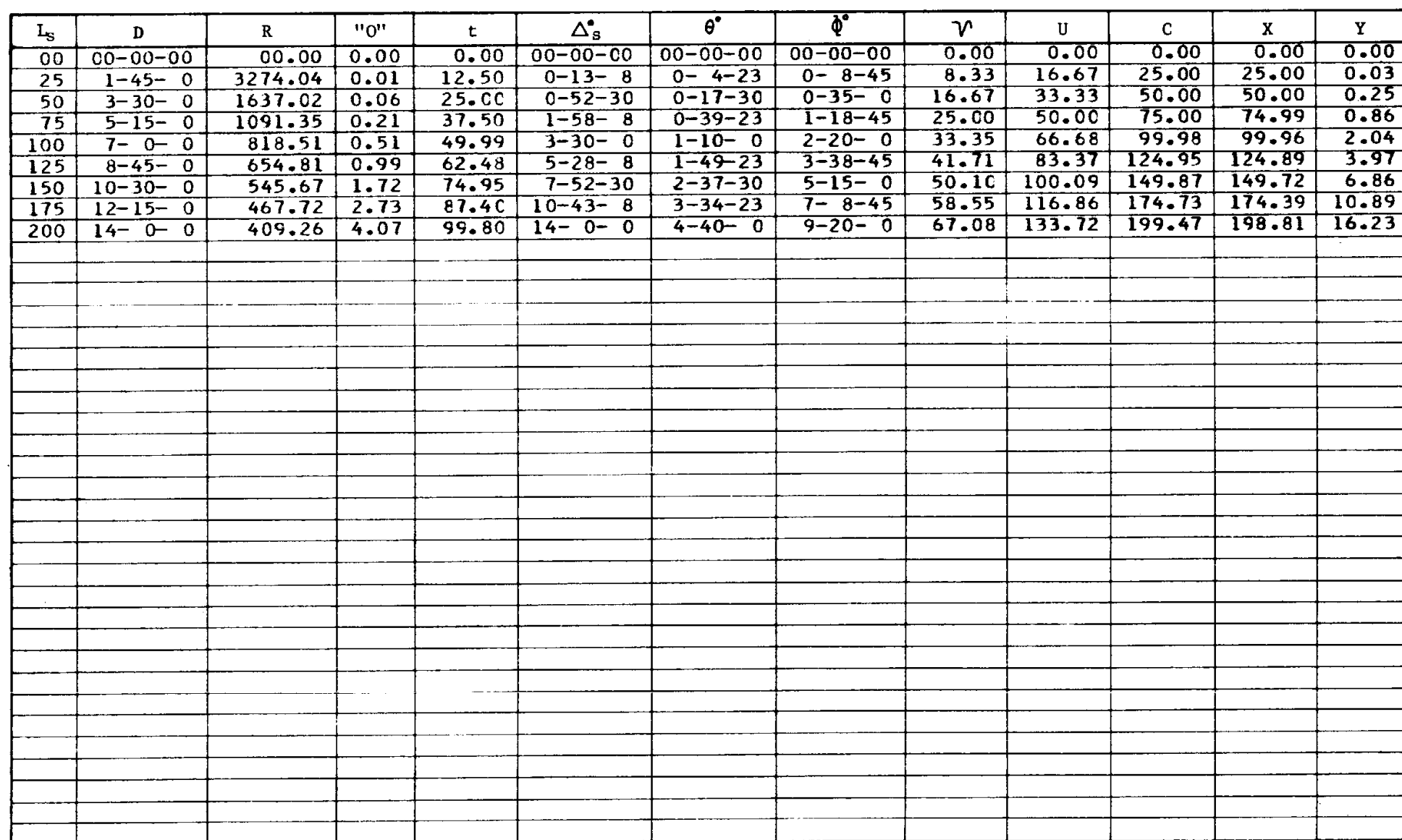
For superelevation distribution,
see Std. D-56.40.



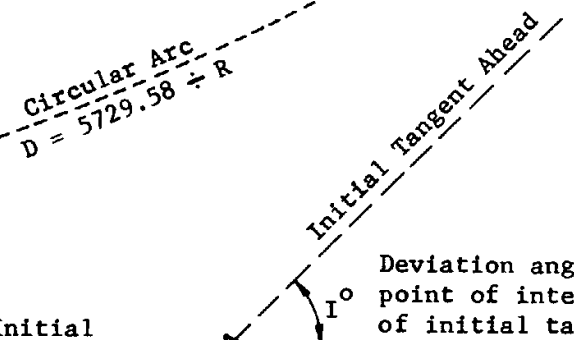
For superelevation distribution,
see Std. D-56.40.



For superelevation distribution,
see Std. D-56.40.



For superelevation distribution,
see Std. D-56.40.



GENERAL NOTES

For definitions of spiral values and their applicable formulae, see Std. D-55.10.



For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

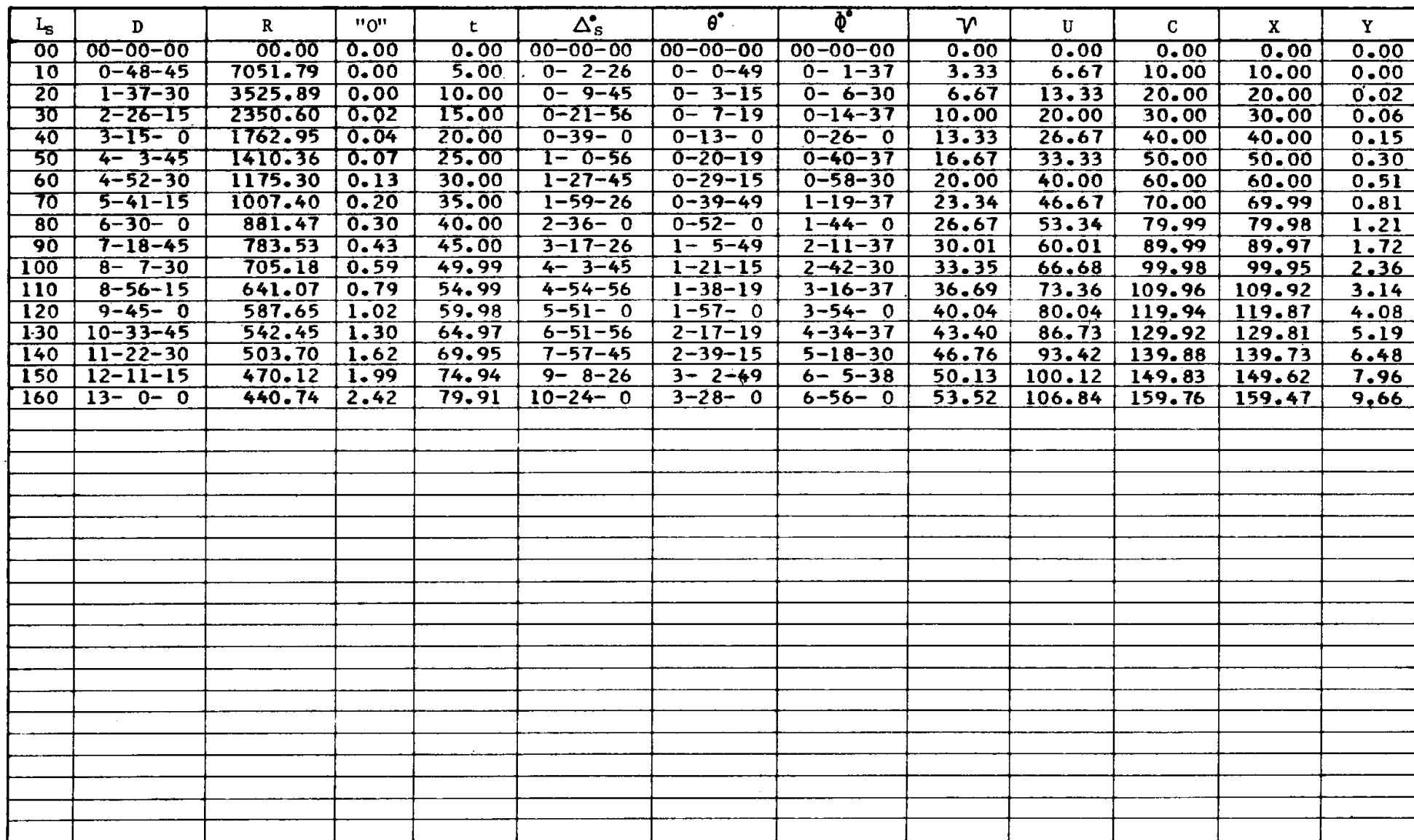
For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

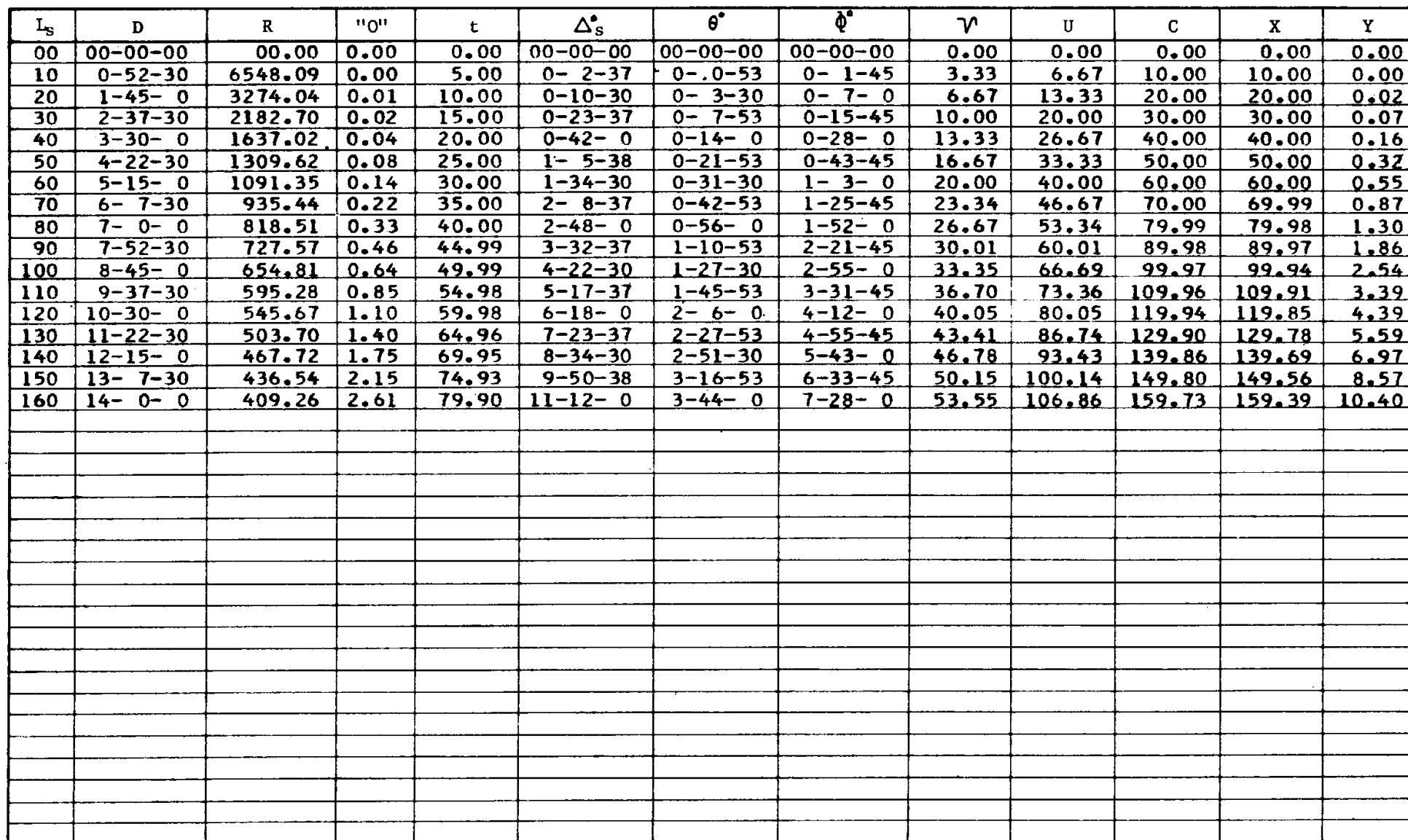
For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

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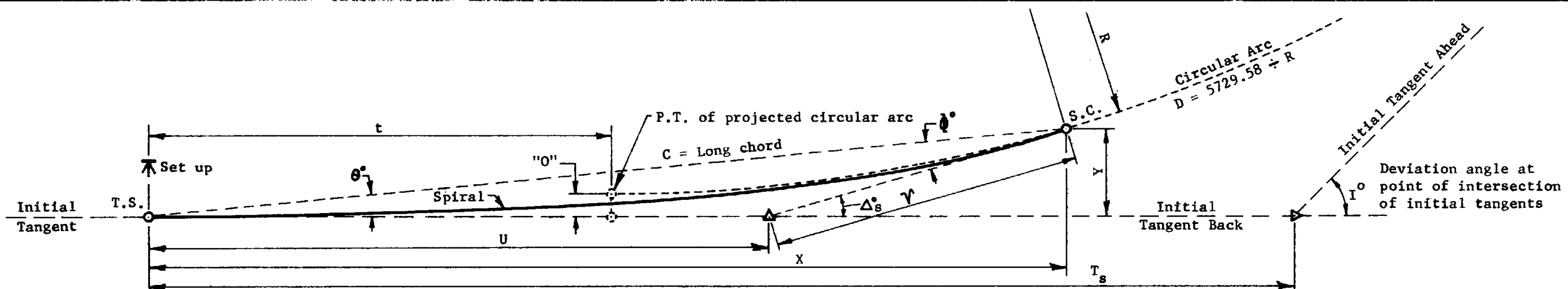


For superelevation distribution,
see Std. D-56.40.



For superelevation distribution,
see Std. D-56.40.

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APPROVED FOR DISTRIBUTION <i>[Signature]</i>	TRANSITION SPIRAL TABLE FOR a=8-3/4	PLAN NO. D-57.90



L_s	D	R	"O"	t	Δ_s°	θ°	ϕ°	V	U	C	X	Y
0	00-00-00	INFINITY	0.00	0.00	00-00-00	00-00-00	00-00-00	0.00	0.00	0.00	0.00	0.00
10	1-00-00	5,729.58	--	5.00	0-03-00	0-01-00	0-02-00	3.33	6.67	10.00	10.00	--
20	2-00-00	2,864.79	.01	10.00	0-12-00	0-04-00	0-08-00	6.67	13.33	20.00	20.00	.02
30	3-00-00	1,909.86	.02	15.00	0-27-00	0-09-00	0-18-00	10.00	20.00	30.00	30.00	.08
40	4-00-00	1,432.40	.05	20.00	0-48-00	0-16-00	0-32-00	13.33	26.67	40.00	40.00	.19
50	5-00-00	1,145.92	.09	25.00	1-15-00	0-25-00	0-50-00	16.67	33.33	50.00	50.00	.36
60	6-00-00	954.93	.16	30.00	1-48-00	0-36-00	1-12-00	20.00	40.00	60.00	60.00	.63
70	7-00-00	818.51	.25	35.00	2-27-00	0-49-00	1-38-00	23.33	46.67	69.99	69.98	1.00
80	8-00-00	716.20	.37	40.00	3-12-00	1-04-00	2-08-00	26.68	53.35	79.99	79.98	1.49
90	9-00-00	636.62	.53	45.00	4-03-00	1-21-00	2-42-00	30.01	60.02	89.98	89.96	2.12
100	10-00-00	572.96	.73	49.99	5-00-00	1-40-00	3-20-00	33.36	66.69	99.97	99.93	2.91
110	11-00-00	520.87	.97	54.98	6-03-00	2-01-00	4-02-00	36.71	73.38	109.95	109.88	3.87
120	12-00-00	477.47	1.26	59.97	7-12-00	2-24-00	4-48-00	40.07	80.07	119.92	119.81	5.02
130	13-00-00	440.74	1.60	64.95	8-27-00	2-49-00	5-38-00	43.43	86.75	129.87	129.71	6.38
140	14-00-00	409.26	1.99	69.93	9-48-00	3-16-00	6-32-00	46.81	93.47	139.82	139.59	7.96
150	15-00-00	381.97	2.45	74.90	11-15-00	3-45-00	7-30-00	50.20	100.19	149.75	149.43	9.79
160	16-00-00	358.10	2.97	79.87	12-48-00	4-16-00	8-32-00	53.61	106.92	159.64	159.20	11.88
170	17-00-00	337.03	3.56	84.82	14-27-00	4-49-00	9-38-00	57.04	113.68	169.52	168.92	14.23
180	18-00-00	318.31	4.24	89.76	16-12-00	5-24-00	10-48-00	60.50	120.46	179.36	178.56	16.88
190	19-00-00	301.56	4.99	94.68	18-03-00	6-01-00	12-02-00	63.99	127.27	189.16	188.12	19.83
200	20-00-00	286.48	5.82	99.59	20-00-00	6-40-00	13-20-00	67.52	134.13	198.92	197.57	23.09
210	21-00-00	272.84	6.73	104.48	22-03-00	7-21-00	14-42-00	71.09	141.01	208.61	206.90	26.69
220	22-00-00	260.44	7.74	109.35	24-12-00	8-04-00	16-08-00	74.71	147.94	218.25	216.09	30.63
230	23-00-00	249.11	8.84	114.18	26-27-00	8-49-00	17-38-00	78.39	154.93	227.81	225.12	34.92
240	24-00-00	238.73	10.05	118.99	28-48-00	9-36-00	19-12-00	82.14	161.99	237.29	233.97	39.57
250	25-00-00	229.18	11.35	123.76	31-15-00	10-25-00	20-50-00	85.98	169.11	246.68	242.61	44.60
260	26-00-00	220.37	12.78	128.49	33-48-00	11-16-00	22-32-00	89.90	176.32	255.96	251.03	50.01
270	27-00-00	212.21	14.31	133.18	36-27-00	12-09-00	24-18-00	93.92	183.63	265.12	259.18	55.80
280	28-00-00	204.63	15.96	137.81	39-12-00	13-04-00	26-08-00	98.21	191.05	274.15	267.05	62.07

GENERAL NOTES

For definitions of spiral values and their applicable formulae, see Std. D-55.10.

For deflection angle formulae for an instrument set-up at a point on spiral, see Std. D-55.10.

For partial transition spiral formulae, see Std. D-55.20.

For spiral transition between compound curves, see Std. D-55.30.

For curvature, superelevation and superelevation transition standards, see Std. D-56.10, D-56.20 and D-56.30.

For superelevation distribution, see Std. D-56.40.

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