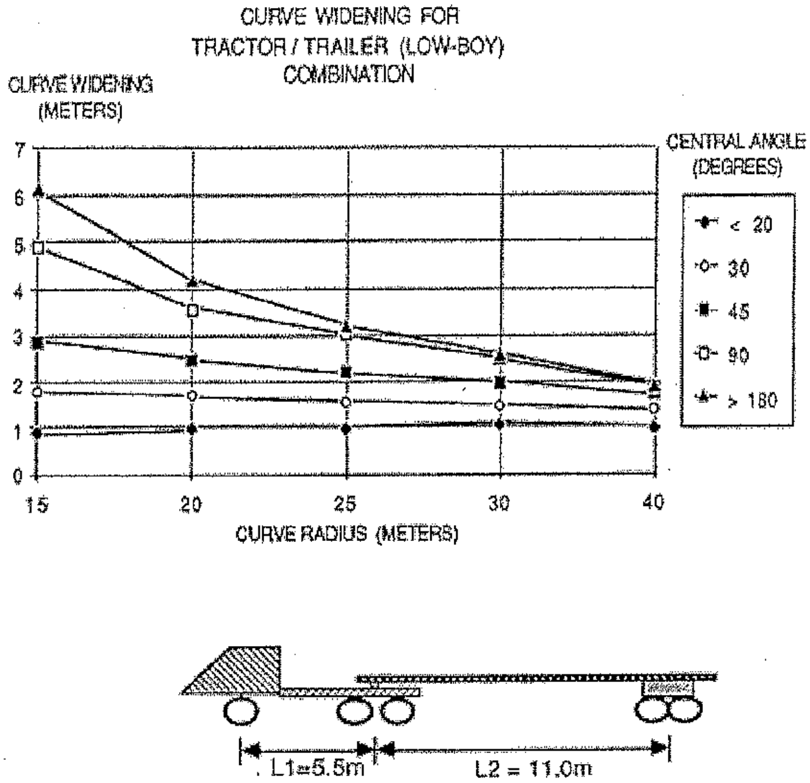
A

United Nations, Forestry Department
Seminar on Environmentally Sound Forest Roads and
Wood Transport. (1998) Roger Hay



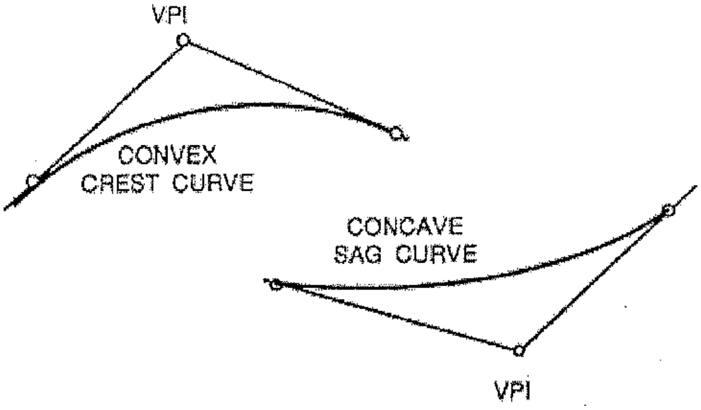
3.1.3 Vertical Alignment

Vertical alignment is often the limiting factor in road design for most forest roads. Frequently grades or tag lines are run at or near the maximum permissible grade. Maximum grades are determined by either vehicle configuration (design/critical vehicle characteristic) or erosive conditions such as soil or precipitation patterns. Depending on road surface type, a typical logging truck can negotiate different grades. Table 16 lists maximum grades a log truck can start from. It should be noted that today's loaded trucks are traction limited and not power limited. They can start on grades up to 25 % on dry, well maintained, unpaved roads. Once in motion they can typically negotiate steeper grades.

Vertical curves or grade changes, like horizontal curves, require proper consideration to minimize earthwork, cost, and erosion damage. Proper evaluation requires an analysis of vertical curve requirements based on traffic characteristics (flow and safety), vehicle geometry, and algebraic difference of intersecting grades.

Vertical curves provide the transition between an incoming grade and an outgoing grade. For convenience in design, a parabolic curve (Figures 39 and 40) is used because the grade change is proportional to the horizontal distance. The grade change is the difference between incoming grade and outgoing grade. The shorter the vertical curve can be kept, the smaller the earthwork required.

Figure 39. Typical vertical curves (VPI = Vertical Point of Intersection).



The grade change per unit length is defined as

$$(G1 - G2) / L \ (\% / \text{meter})$$

or more commonly its inverse, where the grade change is expressed in horizontal distance (meters) to effect a 1% change in grade.

Table 16. Maximum grades log trucks can start on from rest (Cain, 1981).

	Maximum Starting Grades**									**Example**
(1) Surface	(2) Traction Coef. (f)	(3) Rolling Res. (r)	(4)* Starting Res. (s)	(5) TR. = .435 Loaded Truck [a]		(6) TR. = .64 Empty Truck Piggyback [b]		(7) TR. = .32 Empty Truck Trailer Extended [b]		
				From	To	From	To	From	To	
Concrete-dry	.75-.90	.018	.10	21.6	28.1	47.0	61.4	17.6	24.8	Given: earth surface road
Concrete-wet	.55-.70	.15	.10	13.1	19.6	29.6	42.5	9.0	15.5	Req'd: maximum adverse grades for the following:
Asphalt-dry	.55-.70	.020	.10	12.8	19.3	29.4	42.3	8.7	15.2	
Asphalt-wet	.40-.70	.018	.10	6.4	19.4	17.4	42.4	2.8	15.3	1) landings 2) loaded log truck to start from rest 3) moving loaded log trucks
Gravel-packed, oil, & dry	.50-.85	.022	.10	10.5	25.7	26.2	56.3	6.5	22.0	
Gravel-packed, oil, & wet	.40-.80	.020	.10	6.3	23.7	17.4	51.6	2.7	19.8	Assume hauling will be done during wet weather, but not ice or snow
Gravel-loose, dry	.40-.70	.030	.10	5.7	18.8	17.0	42.0	2.0	14.5	
Gravel-loose, wet	.36-.75	.040	.10	3.4	20.4	13.6	46.2	-0.2	16.1	Solution: Under Column (1), find earth-wet:

Rock-crushed, wet or dry	.55-.75	.030	.10	12.2	20.9	29.0	46.5	8.0	16.8	1) for landing, go across to Col. (7) truck, trailer extended, and read from 2.0 to 6.5 %.
Earth-dry	.55-.65	.022-.03	.10	12.2	17.0	29.0	37.8	8.0	12.8	2) for loaded log trucks starting from rest, go across to Col. (5) and read from 5.7 to 10.5 %.
Earth-wet (excludes some clays)	.40-.50	.022-.03	.10	5.7	10.5	17.0	25.2	2.0	6.5	3) add 10 % to part 2, which means a moving loaded log truck will 'spin out' somewhere between 15.7 to 20.5 %.
Dry packed snow	.20-.55	.025	.10	- 2.7	12.5	2.5	29.2	- 5.0	8.4	NOTE
Loose snow	.10-.60	.045	.10	- 8.2	13.6	- 5.1	32.7	- 9.8	9.1	Extreme caution is recommended in the use of steep grades, especially over 20 %. They may be impractical because of construction and maintenance problems and may cause vehicles that travel in the downhill direction to lose control.
Snow lightly sanded	29-.31	.025	.10	1.2	2.1	8.9	10.4	-1.8	-1.0	
Snow lightly sanded with chains	.34	.035	.10	2.8		12.3		0.6		
Ice without chains	.07-.12	.005	.10	-7.2	-5.1	- 5.6	-2.3	-8.1	-6.4	

*For vehicles with manual transmissions. Factor for wet clutches, hydraulic torque converters, freeshaft turbines, or hydrostatic transmissions would be .03 to .05.

**Add 10 % to these values to obtain the maximum grade a log truck may negotiate when moving

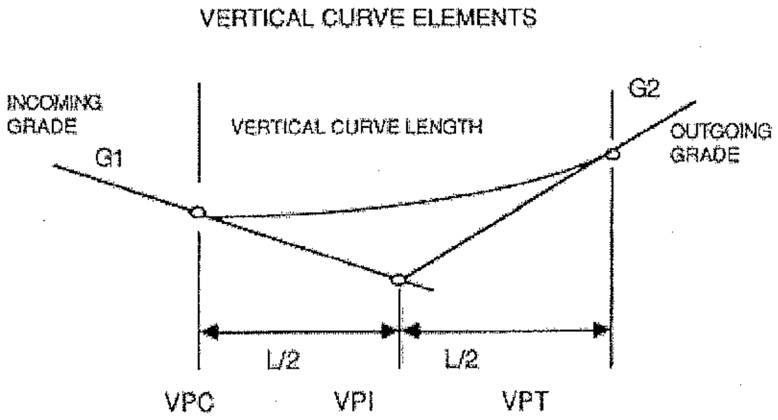
[a] Based upon = f(TR) - r(1 - TR) - S

[b] Based upon = f(TR)/(1 - (f(h)/b)) - r(1 - TR) - S

h = height of trailer coupling or center of gravity (1.2 m)

b = wheel base (5.5 m) formulas from source 2 values in Col. 2 & 3 are composite.

Figure 40. Vertical curve elements (VPC = Vertical Point of Curvature; VPT = Vertical Point of Tangency).



Factors to be considered in the selection of a vertical curve are:

Stopping Sight distance S: On crest curves, S is a function of overall design speed of the road and driver's comfort. On most forest roads with design speeds from 15 km/hr to 30 km/hr, the minimum stopping sight distance is 20 and 55 meters respectively (see Ch. 2.1.2.7). Kuonen (1983) provides an equation for minimal vertical curve length based on stopping distance:

Lmin = Smin2 / 800

where: Lmin = minimum vertical curve length for each 1 % change in grade (m / %)
Smin = minimum safe stopping sight distance (m)

Example: Determine the minimum vertical curve length for a crest curve that satisfies the safe stopping sight distance.

Design speed of road: 25 km/hr
Grade change (G1 - G2): 20 %

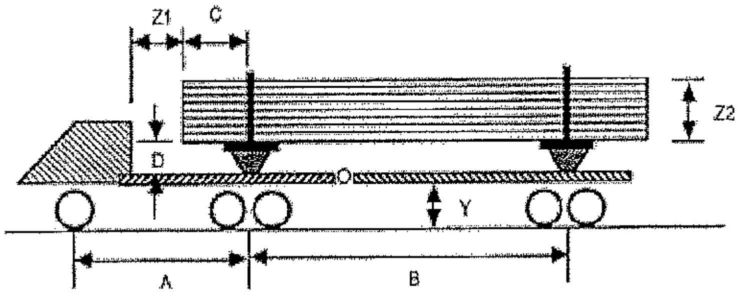
Solution: Stopping sight distance for 25 km/hr equals approximately 37 meters (from Ch. 2.1.2.7).

Lmin = (37(2) / 800) 20 = 34.2 m

Vehicle geometry: Vehicle clearance, axle spacing, front and rear overhang, freedom of vertical movement at articulation points are all factors to be considered in vertical curve design.

Passage through a sag curve requires careful evaluation of the dimensions as illustrated in Figure 41.

Figure 41. Log truck geometry and dimensions for vertical curve analysis



D = Clearance between top of the frame of the truck and the bottom of the logs at the front
Y = Distance between the ground and the bottom of the trailer reach or stinger
Z1= Distance between the front of the logs and the cab of the truck which depend on C and Z2
Z2= Height of log load

The critical dimensions of a log truck when analyzing crest vertical curves are the length of the stinger and the vertical distance between the stinger and the bottom of the logs, x. A log truck as shown in Figure 41 with dimension

A - Tractor length	=	4.8 m
B - Bunk to Bunk	=	7.2 m
C - Log overhang front	=	2.4 m
D - Clearance log - frame	=	0.39 m

could negotiate a grade change of 30% over a vertical curve length of 12 m without damage to the truck (Ohmstede, 1976).

As shown in the previous example , safety considerations typically require significantly longer, vertical curves than physical truck dimensions do. With the exception of special or critical vehicles, vertical curves can be kept very short, even for large grade changes. Road maintenance considerations are more important in such situations. Vehicle dimension considerations do become important, however, in special cases such as fords in creek crossings.

3.2 Road Prism

Proper design of the roadway prism can significantly reduce the amount of sediment and debris that enters adjacent streams. Often the basic cause of a particular mass failure can be traced to overroading or overdesign. Overroading or misplacement of roads results from a poor land management or transportation plan; overdesign results from rigidly following design criteria with respect to curvature, width, gradient, and oversteepened cuts and fills or from designing roads to higher standards than are required for their intended use. As stated previously, allowing terrain characteristics to govern road design permits more flexibility and will be especially beneficial, both environmentally and economically, where it is possible to reduce cut and fill slope heights, slope angles, and roadway widths.

3.2.1 Road Prism Stability

Stability considerations as applied to natural slopes are also valid for stability analysis of road cuts and fills. Points to consider include

- Critical height of cut slope or fill slope
- Critical piezometric level in a slope or road fill
- Critical cut slope and fill slope angle.

The most common road fill or sidecast failure mode is a translational slope failure. Translational slope failure is characterized by a planar failure surface parallel to the ground or slope. Depth to length ratio of slides are typically very small. The following slopes would fall into this category:

1. Thin, residual soil overlaying an inclined bedrock contact
2. Bedrock slopes covered with glacial till or colluvium
3. Homogeneous slopes of coarse textured, cohesionless soils (road fills)

Fill slope failure can occur in two typical modes. Shallow sloughing at the outside margins of a fill is an example of limited slope failure which contributes significantly to erosion and sedimentation but does not directly threaten the road. It is usually the result of inadequate surface protection. The other is sliding of the entire fill along a contact plane which can be the original slope surface or may include some additional soil layers. It results from lack of proper fill compaction and/or building on too steep a side slope. Another reason could be a weak soil layer which fails under the additional weight placed on it by the fill.

Slope or fill failure is caused when forces causing or promoting failure exceed forces resisting failure (cohesion, friction, etc.). The risk of failure is expressed through the factor of safety (see Figure 2):

$$FS = \text{Shear strength} / \text{Shear stress}$$

where shear strength is defined as

$$T = C * A + N (\tan [f])$$

and shear stress, the force acting along the slope surface, is defined as

$$D = W * \sin [b]$$

2004

sidewalks, utilities, additional lanes, and possible bicycle facilities. For further information on landscaping, see the AASHTO *Guide for Transportation Landscape and Environmental Design* (9).

Bicycle Facilities

Local roadways and streets are generally sufficient to accommodate bicycle traffic. However, where special facilities are desired, they should be planned and designed in accordance with the AASHTO *Guide for the Development of Bicycle Facilities* (1).

SPECIAL-PURPOSE ROADS

Introduction

For the purpose of design, highways have been classified in this book by function with specific design criteria for each functional class. Subsequent chapters discuss the design of collectors, arterials, and freeways. The first two sections of this chapter discuss the design of local roads and streets. Another type of local road, however, is different because of its purpose and does not fit into any of the classifications identified above. This type of local road is referred to as a special-purpose road and because of its unique character, separate design criteria are provided. Special-purpose roads include recreational roads, resource recovery roads, and local service roads. Roads in the special-purpose category are generally lightly traveled and operate with low traffic speeds; for these reasons, the design criteria for special-purpose roads differ from those for other roadway types.

Recreational Roads

General Considerations

Roads serving recreational sites and areas are unique in that they are also part of the recreational experience. Design criteria described below meet the unusual demands on roads for access to, through, and within recreational sites, areas, and facilities for the complete enjoyment of the recreationist. The criteria are intended to protect and enhance the existing aesthetic, ecological, environmental, and cultural amenities that form the basis for distinguishing each particular recreational site or area.

Visitors to a recreational site need access to the general area, usually by a statewide or principal arterial highway. Secondly, they need access to the specific recreational site. This is the most important link from the statewide road system. For continuity beyond this point, design criteria assume that the visitor is aware of the recreational nature of the area. The design should be accomplished by a multidisciplinary team of varied backgrounds and experience in order to ultimately provide a road system that is an integral part of the recreational site. Depending on the conditions, internal tributaries will have a variety of lower design features.

The criteria discussed in this chapter are applicable for public roads within all types of recreational sites and areas. Design criteria for recreational roads are discussed for primary access roads, circulation roads, and area roads. Primary access roads are defined as roads that allow through movement into and between access areas. Circulation roads allow movement between activity sites within an access area, whereas area roads allow direct access to individual activity areas, such as campgrounds, park areas, boat launching ramps, picnic groves, and scenic and historic sites.

Exhibit 5-12 depicts a potential road system serving a recreational area. Road links are labeled in accordance with the classification system noted.

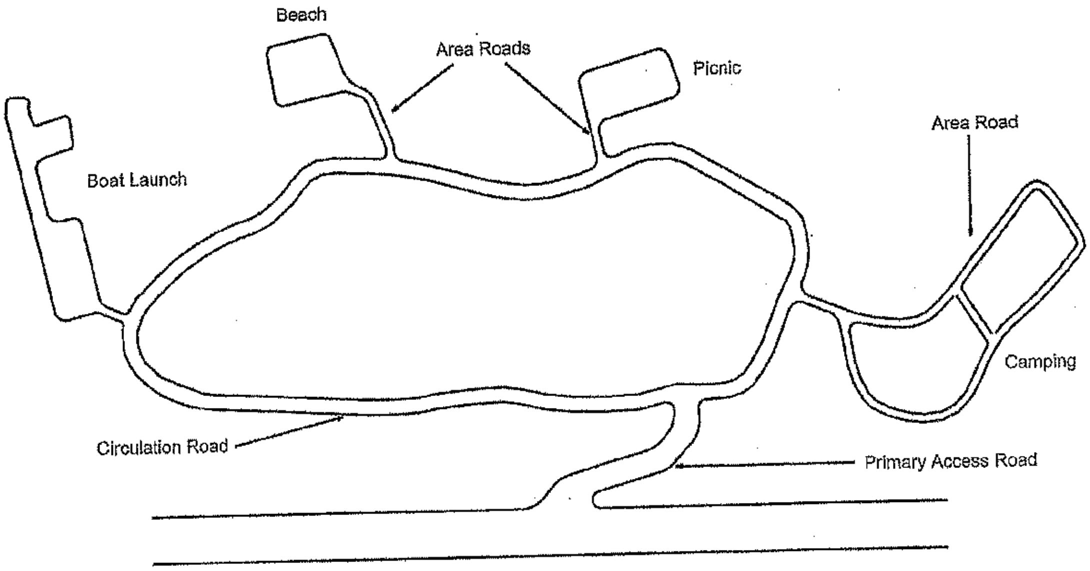


Exhibit 5-12. Potential Road Network

Design Speed

The effect of design speed on various roadway features is considered in its selection; however, the speed is selected primarily on the basis of the character of the terrain and the functional classification of the road. The design speeds should be approximately 60 km/h [40 mph] for primary access roads, 50 km/h [30 mph] for circulation roads, and 30 km/h [20 mph] for area roads. There may be instances where design speeds less than these may be appropriate because of severe terrain conditions or major environmental concerns. Design speeds on one-lane roads would usually be less than 50 km/h [30 mph]. If a design speed of greater than 60 km/h [40 mph] is used, the first section of this chapter should be consulted.

Design speed is the principal factor that should be correlated with the physical features of design to achieve a roadway that will accommodate the traffic safely for the planned use. Once a design speed is selected, all geometric features should be related to this speed to obtain a balanced design. Changes in terrain and other physical controls may dictate a change in design speed in certain sections. A decrease in design speed along the road should not be introduced abruptly, but be extended over a sufficient distance to allow the driver to adjust and make the transition to the slower speed.

Design Vehicle

The physical dimensions and operating characteristics of vehicles and the percentage of vehicles of various sizes using recreational roads are primary geometric design controls. Existing and anticipated vehicle types should be reviewed to establish representative vehicles for each functional roadway class. Each design vehicle considered should represent a substantial percentage of the vehicles expected to use the facility during its design life.

Three categories of vehicles are common to recreational areas: motor homes, vehicles with trailers, and standard passenger vehicles. Critical physical dimensions for geometric design are the overall length, width, and height of these units. Minimum turning paths of the design vehicles are influenced by the vehicle steering mechanism, track width, and wheelbase arrangement. Figures in Chapter 2 show minimum turn paths for motor homes (MH), passenger cars with 9-m [30-ft] travel trailers (P/T), passenger cars with 6.1-m [20-ft] boats (P/B), and motor homes with 6.1-m [20-ft] boats (MH/B). Turning path dimensions for other vehicle types such as buses and passenger cars are also presented in Chapter 2.

Sight Distance

Minimum stopping sight distance and passing sight distance are a direct function of the design speed. The subject of sight distance for two-lane roads is addressed in Chapter 3; however, sight distance design criteria are not included in Chapter 3 for roads with very low design speeds and for two-way single-lane roads. On two-way single-lane roads, sufficient sight distance should be available whenever two vehicles might approach one another for one vehicle to reach a turnout or for both vehicles to stop before colliding. Stopping sight distance should be measured using an eye height of 1 080 mm [3.5 ft] and a height of opposing vehicle of 1 300 mm [4.25 ft]. The stopping sight distance for a two-way, single-lane road should be approximately twice the stopping sight distance that would be used in design of a comparable two-lane road. Suggested stopping sight distances for two-way, single-lane roads are given in Exhibit 5-13.

Passing Sight Distance

Because of low operating speeds and the nature of travel on recreational roads, frequent passing maneuvers are not anticipated. Nevertheless, minimum passing sight distance should be

Metric				US Customary			
Initial speed (km/h)	Design stopping sight distance (m)	Rate of vertical curvature, K^a (m/%)		Initial speed (mph)	Design stopping sight distance (ft)	Rate of vertical curvature, K^a (ft/%)	
		Crest	Sag			Crest	Sag
Two-lane roads and one-way, single-lane roads				Two-lane roads and one-way, single-lane roads			
20	20	1	3	15	80	3	10
30	35	2	6	20	115	7	17
40	50	4	9	25	155	12	26
50	65	7	13	30	200	19	37
60	85	11	18	35	250	29	49
70	105	17	23	40	305	44	64
Two-way, single-lane roads				Two-way, single-lane roads			
20	40	2	6	15	160	12	27
30	70	7	13	20	230	25	44
40	100	15	21	25	310	45	65
50	130	26	29	30	400	74	89
60	170	44	40	35	500	116	117
70	210	67	52	40	610	172	147

[a] Rate of vertical curvature, K, is the length of curve per percent algebraic difference in the intersecting grades (i.e., $K = L/A$). (See Chapter 3 for details.)

Exhibit 5-13. Design Controls for Stopping Sight Distance and for Crest and Sag Vertical Curves—Recreational Roads

provided as frequently as possible, particularly on primary access roads where users travel considerable distances to reach activity sites. Suggested minimum passing sight distances for two-lane recreational roads are given in Exhibit 5-14. Passing sight distance is not a factor on single-lane roads. Where a faster vehicle approaches a slower vehicle from behind, it is assumed that, where appropriate, the slower vehicle will pull into a turnout and allow the faster vehicle to pass.

Grades

Grade design for recreational roads differs substantially from that for rural highways in that the weight/power ratio of recreational vehicles (RVs) seldom exceeds 30 kg/kW [50 lb/hp], and this fact indicates that gradeability of RVs approaches that for passenger cars. Furthermore, because vehicle operating speeds on recreational roads are relatively low, large speed reductions on grades are not anticipated.

Metric			US Customary		
Design speed (km/h)	Design passing sight distance (m)	Rate of vertical curvature, K^a (m/%)	Design speed (mph)	Design passing sight distance (ft)	Rate of vertical curvature, K^a (ft/%)
30	200	46	20	710	180
40	270	84	25	900	289
50	345	138	30	1090	424
60	410	195	35	1280	585
70	485	272	40	1470	772
80	540	338	45	1625	943
90	615	438	50	1835	1203
100	670	520	55	1985	1407
110	730	617	60	2135	1628
120	775	695	65	2285	1865
130	815	769	70	2480	2197
			75	2580	2377
			80	2680	2565

[a] Rate of vertical curvature, K, is the length of curve per percent algebraic difference in the intersecting grades; i.e., $K = L/A$. (See Chapter 3 for details.)

Exhibit 5-14. Design Controls for Passing Sight Distance for Crest Vertical Curves—Recreational Roads

When grades are kept within the suggested limits, critical length of grade is not a major concern for most recreational roads. Critical length of grade may be a factor on primary access roads to recreational areas, and appropriate consideration should be given to this element in the design for these roads.

Exhibit 5-15 identifies suggested maximum grades for given terrain and design speed based primarily on the operational performance of vehicles that use recreational roads. Chapter 3 contains a more detailed discussion on the selection of an appropriate maximum grade. A major item to be considered in selection of a maximum grade is the capability of the soil for erosion resistance. In many instances, grades considerably less than those shown in Exhibit 5-15 should be chosen to satisfy this concern. In addition, the surface type should also be a factor in grade selection. Steep grades with dirt or gravel surfaces may cause driving problems in the absence of continued maintenance, whereas a bituminous surface generally will offer better vehicle performance.

Type of terrain	Metric Maximum grade (%) for a specified design speed (km/h)					US Customary Maximum grade (%) for a specified design speed (mph)				
	20	30	40	50	60	10	20	25	30	40
Level	8	8	7	7	7	8	8	7	7	7
Rolling	12	11	10	10	9	12	11	10	10	9
Mountainous	18	16	15	14	12	18	16	15	14	12

Exhibit 5-15. Maximum Grades for Recreational Roads

Vertical Alignment

Vertical curves should be safe, comfortable in operation, pleasing in appearance, and adequate for drainage. Minimum or greater-than-minimum stopping sight distance should be provided in all cases. The designer should exercise considerable judgment in designing vertical curves because lengths in excess of the minimum may be needed at driver decision points, where drainage or aesthetic problems exist, or simply to provide an additional margin of safety.

Vertical curve design for two-lane roads is discussed in Chapter 3, which also presents specific design values. Exhibit 5-13 also includes additional information for very low design speeds not tabulated elsewhere. For two-way, single-lane roads, crest vertical curves should be significantly longer than those for two-lane roads. As discussed above, the stopping sight distance for a two-way, single-lane road should be approximately twice the stopping sight distance for a comparable two-lane road. Exhibit 5-13 includes K values for single-lane roads, from which vertical curve lengths can be determined.

Horizontal Alignment

Because the use of straight sections of roadway would be physically impractical and aesthetically undesirable, horizontal curves are essential elements in the design of recreational roads. The proper relationship between design speed and horizontal curvature and the relationship of both to superelevation are discussed in detail in Chapter 3. The guidance provided in Chapter 3 is generally applicable to paved recreational-roads; however, in certain instances variations are appropriate. At locations where there is a tendency to drive slowly, as with local and some circulation roads, a maximum superelevation rate of 6 percent is suggested. On roads with design speeds of 30 km/h [20 mph] or less, superelevation may not be warranted.

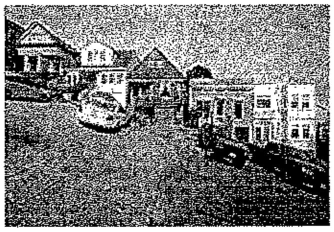
The design values for maximum curvature and superelevation discussed in Chapter 3 are based on friction data for paved surfaces. Some lower volume recreational facilities may not be paved, and because friction values for gravel surfaces are less than those for paved surfaces, friction values should be considered in curvature selection. Exhibit 5-16 shows the relationship

The Steeps Of San Francisco

In Search Of The City's Steepest Street

BY STEPHEN VON WORLEY ON NOVEMBER 10, 2009

Ask a San Franciscan about the City's steepest streets, and four out of five times, he'll say something like "Great for scaring the bejeezus out of tourists!"



A Steep San Francisco Street

Or, sweat beading upon his brow, he might recount that Damp Morning when he drove his Manual Transmission up the Impossible Grade, and was forced to stop, just below the top! In frantic pantomime, he'll pull the emergency brake and disengage the clutch. Crane his neck to peer anxiously at the car sniffing his downhill bumper. Bulge his eyes. Gun the engine. Pop the clutch. Release the brakes. Lay down some rubber with a piercing squeal. Float his steed slowly onto the flat. Wave the smoke from his eyes. Pump his arms in brief celebration. And finally, grouse about that **sadistic** driving instructor who got him into the pickle in the first place. What a jerk!

Flush with the desire to frighten out-of-town guests, or to take the aforementioned test of motoring skill, you'll need a suitable road with hill. Google the "**steepest streets in San Francisco**" and you'll find this:

The Steepest Streets in the City, Purportedly
1. (tie) Filbert between Leavenworth and Hyde (31.5% grade)
1. (tie) 22nd between Church and Vicksburg (31.5% grade)
3. Jones between Union and Filbert (29% grade)
4. Duboce between Buena Vista and Alpine (27.9% grade)
5. Jones between Green and Union (26% grade)
6. Webster between Vallejo and Broadway (26% grade)
7. Duboce between Alpine and Divisadero (25% grade)
8. Jones between Pine and California (24.8 grade)
9. Fillmore between Vallejo and Broadway (24% grade)

Source: San Francisco Bureau Of Engineering.

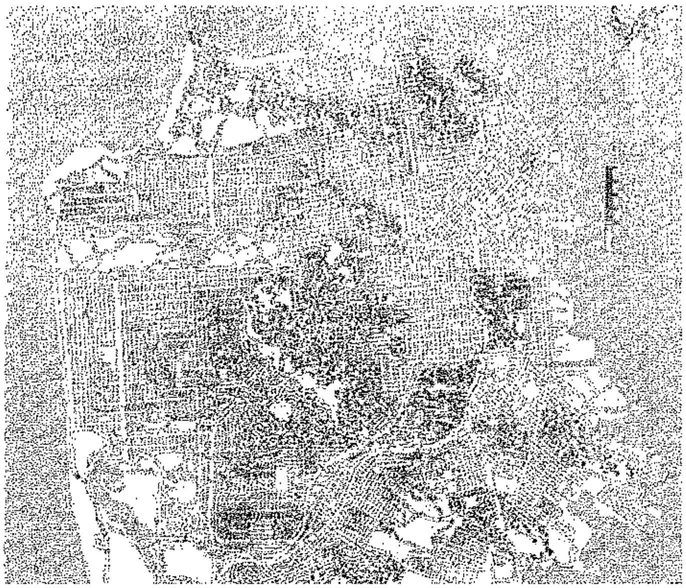
Impressive? Most certainly. However, might I register a beef, please?

The grade measurements look okay, but the locations overlap the traditional haunts of hipsters and sightseers, seemingly to the exclusion of the rest of town. Hills dot the entirety of the City, so a similarly-steep street must lurk elsewhere within its 49 square miles. Right?

At the exact moment of that realization, my inner Chivalrous Knight rose from slumber, knowing that he must canvas every corner of San Francisco, no matter how nondescript or unpleasant, for its steepest thoroughfares – if for no other reason than the Defense Of Equitability and Advancement Of Knowledge.

A Map!

Frisco encompasses some 1,400 miles of paved roads, so the first step was to narrow my search. Combining the **National Elevation Dataset's** 1/3-second data with the **Open Street Maps** grid, I created the following map of the City, with streets colored by slope:



A map of San Francisco with streets colored by slope.

Despite the map's warts – and a geography geek will find more than a few – it served its purpose: to pinpoint areas of interest. After scouring the associated **topos**, I'd assembled a dozen candidate intersections, ripe for inspection.

The next day, I loaded my crude surveying rig – a level and builder's square – into the car, checked the brakes, changed the oil, kissed my wife and kids goodbye, mumbled a prayer to **Saint Christopher**, and embarked upon the ***Steepest Search.***

High Grade

Most people naturally describe steepness with an angle. However, road builders speak in *grade*, the ratio of vertical rise to horizontal run, expressed as a percentage, allowing them to quickly perform useful calculations without resorting to Troublesome Trigonometry. Angle and grade ***are not synonymous:*** for example, a slope that rises one foot per two feet of run is about 27 degrees from level, but has a grade of 50%. With that in mind, let's continue!

My first target was **10th Avenue** above Quintara, a straight shot to the top of Forest Hill. On approach, it looked mighty indeed, and measurements showed 4.75 inches of rise per 20 inches of run: a respectable, but not record-shattering 24% grade. The subsequent procession of streets – on Mount Sutro, below Twin Peaks, in Diamond Heights – clocked in likewise: at 23%, 24%, and 25%, ***but nothing steeper!***

A century ago, when San Franciscans began swapping their goat-drawn carriages for automobiles, some wise authority must have decided that these new-fangled mechanical animals could not safely climb more than one foot in four. And issued a proclamation: no new street shall exceed 25-Percent!

Baden

In support of that theory, the Parade of One-In-Four Grades continued for two more hours, until abruptly terminated by this extremely-steep ribbon of pavement atop Frisco's Sunnyside:

The 400 block of Baden

Was it a public street? The local postman didn't think so, but the city signage, as the dead-end 400 block of **Baden**, indicated otherwise. However, it ***was*** stubby, one lane wide, textured like a lava flow, and if it wasn't a driveway, it certainly ***ended*** at one.

Baden's lumpiness raised a pertinent question: how to determine the maximum grade? Consider too short a stretch, and potholes, bumps, and gutters skew the numbers. Too long, and the flats drown out the steeps. My eminently-practical compromise defines maximum grade as the most you can tilt your car, axle to axle, driving the road while keeping the wheels on the pavement and avoiding damage.

Measured accordingly, upper Baden topped out at 34 percent: worthy of breaking out the champagne, if it were a bonafide street other than by technicality!

Bernal

In the Hollywood Adaptation of the Steepest Search, I had reached the dark part of the script, wherein Circumstance tests my Mettle. Sure, I'd assembled the Twenty-Five-Percent Collection and discovered a Heavily-Tilted Single Lane Road With Asterisk. But, despite my best efforts, a full-fledged specimen of truly extreme slope eluded me!

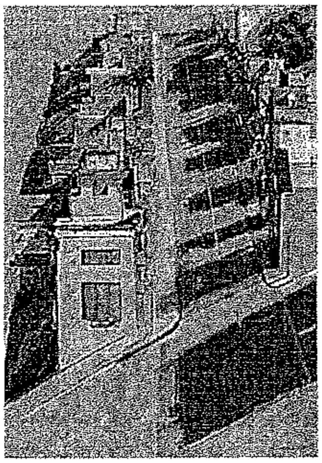
Frustration cast a smug grin in my direction, and I winked back, for I had an Ace Up My Sleeve: **Bernal Heights**!

In any *sane* city, a superlative hill like Bernal would have been left completely bare. However, San Francisco was crazy before the **1906 temblor**, and a basket case afterwards. Bernal escaped the brunt of the damage, so, to house refugees and the workers who would rebuild the city, the powers-that-be hastily completed and populated its network of narrow streets. These charismatic thoroughfares persist to this day: arranged in a grid here, a jumble there, with dipsy doodles everywhere! Given the chance, don't miss the staccato ramps and flats of **Prospect Avenue**. Or, to experience the sensation of being One Hair Shy Of Tumbling Off The Edge Of The World, drive **Elsie Street** from Virginia to Coso!

Bernal oozes good, funky karma, so poetically, upon its northern flanks, I found Redemption.

Ripley

At first, I didn't know whether to believe it or not. Could this be an illusion? A dream? I rubbed my eyes, pinched myself, and looked again. Still, it persisted: **Ripley Street**, a beautiful, continuous grade, paved in the tell-tale concrete, jutting bravely skyward! With the hallmark, mandatory parking perpendicular to the slope, lest the ever-tugging hand of Mother Gravity transform one's hapless vehicle into two-thousand-pound Battering Ram Of Rolling Carnage.



Thiebaud's "Ripley Street Ridge"

I jumped from my auto, ran hurriedly to mid-grade, and took a measurement: 31.5 percent! The same pitch as Filbert and 22nd Streets, but with longer sustain, and drivable both ways!

On the topic of Ripley, the Internet Dot Com is more-or-less mum, with one notable exception: renowned painter Thiebaud's evocative, spot-on, and sought-after ***Ripley Street Ridge***, recently sold at auction for a cool $1,022,500.

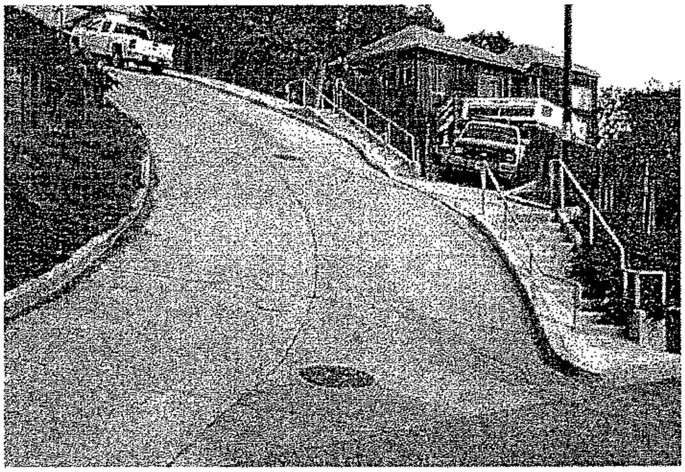
More coarsely, if San Francisco's other steep streets are Boys, Ripley is The Daddy: a broad-shouldered, dominating 400-foot stretch of peeling tires, boiling radiators, and grinding brake pads! Lose control on lesser inclines, and via the proper application of wits, reflexes, hedges, curbs, side streets, and other cars, you just might be able to negotiate a Happy Ending. But screw with Ripley, and you will certainly endure a most Severe Punishment upon the Bottom!

Nevada and Prentiss

Finally satisfied by my discoveries, I headed home to dine with family. Alas, in transit, slightly below Bernal's rim boulevard, I lost my bearings. The steering wheel of fate guided me into a vaguely-rural area – so steep that half of its lots are vacant.

There, I encountered **Nevada**, a stripe of loose, dirty asphalt that cascades downhill at a lunch-tossing 36 percent. If you have a heart condition, serious back problems, frequent motion sickness, or are under 48 inches tall, do not attempt to drive it, for a local resident informs me that unlucky motorists lock up in fear and/or careen by on a weekly basis.

Thirty seconds after gingerly exiting Nevada, I rendezvoused with a sassy, petite, curved, concrete street by the name of **Prentiss**:



Prentiss Street above Powhattan

Drive downhill along the inside edge of the turn, and your car will briefly tilt at an astounding 37% grade. Hubba hubba!

Congratulations, Prentiss Street between Chapman and Powhattan, for you have officially earned the title of San Francisco's Steepest. You soundly trounce your Californian competition, and cross the finish line nose to nose with Pittsburgh's **Canton Avenue**, tied as the two most-tilted urban thoroughfares ***in the world!***

New And Improved

Now, with that and some other discoveries in hand, let's finish the job. Fire the pyrotechnics in five, four, three, two, one...

The Steepest Streets In San Francisco, For Real

1. Prentiss between Chapman and Powhattan (37% grade)
2. Nevada above Chapman (36% grade)
3. Baden above Mangels (34% grade) *
4. Ripley between Peralta and Alabama (31.5% grade)
5. Filbert between Hyde and Leavenworth (31.5% grade)
6. 22nd between Vicksburg and Church (31.5% grade)
7. 24th between Grand View and Fountain (30% grade)
8. Kearny above Broadway (30% grade) **
9. Holyoke between Karen and Woolsey (30% grade)
10. 25th above Grand View (30% grade)
11. Jones between Union and Filbert (29% grade)
12. Dwight above Goettingen (29% grade)
13. Folsom between Chapman and Powhattan (29% grade)

Source: Stephen Von Worley.
Notes: Ties are broken by the length of maximum slope.
** Crude, single lane pseudo-street, ** Grade unconfirmed.*

Mission Accomplished. Inner Chivalrous Knight, time for beddie bye!

Please do read the sequel: More Steeps Of San Francisco!

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