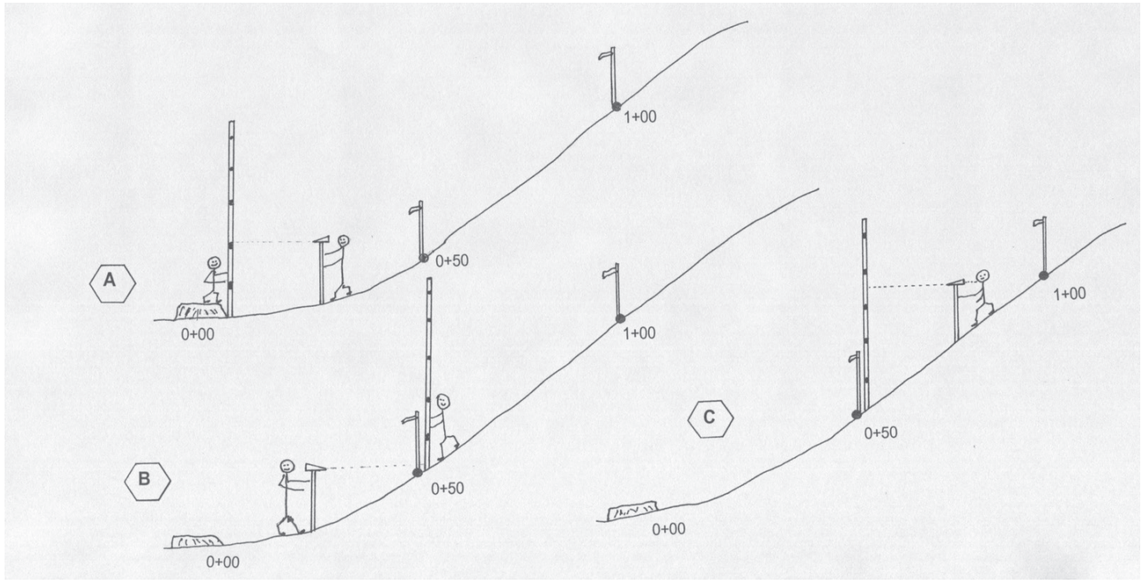
Figure 3. Process of collecting data for the road profile.



The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; home economics; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of Cooperative Extension are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and based on factual information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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Basics of Forest Road Surveying

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Development of sound forest roads is one of the major parameters influencing overall timber harvesting activities within the perspective of sustainable forestry. This fact sheet summarizes some of the main aspects of forest road surveying, establishing curves and determining overall road length and profile of the road.

Gradeline is the route establishing a survey line to follow a typical forest road. It can be easily determined by a two-man crew using a clinometer (abney level) and flagging. While one man holds the flag at eye level, the other person can determine grade using a clinometer. Usually the clinometer person moves ahead to determine his grade point by looking back at his eye height of the other person and station that is marked by driving a stake. Stakes are driven at predetermined intervals, which is usually around 50 feet and identified as an individual station. When establishing the grade line, it is important not to exceed maximum grade limits depending on overall topography of the site. Figure 1 shows a schematic of gradeline in the field. Tangents of the road are established by dividing a zigzag configuration of the gradeline into equal portions as much as possible. Once tangents are identified, curves of the road are determined based on the intersections of two tangents, which is the point of intersection (PI), and complete centerline of the road is established. Depending on topography of the site and distance, there could be several or more curves on the road. Point of intersection of each curve should be marked by stakes in addition to each station. Bearing, which is the location direction and target point of each tangent, also should be determined using a compass.

Delta angle for each curve is calculated in the next step. Required parameters for each curve, namely external (E), point of curvature (PC) and point of tangency (PT) are calculated to determine geometry of each curve. External is the distance between PI and the closest point of the curve, and it is determined by measuring in the field. Derived from delta angle and E value, degree of the curve, which is defined by the angle subtended by 100 feet in the curve, is calculated based on table values**.** Figure 2 illustrates an example of establishing the centerline and calculations of curve parameters. In this example, the total length of the road will be determined by measuring from the first station to PC plus the length of the curve and distance from PT to the end of the road, which is the last station. When all measurements are obtained in the field, they are added together, and the total length of the road is determined. Also, data gathered in the field are transferred to engineering paper in the form of a scaled drawing so the parameters of the road can simply be quantified.

Most of the time forest road construction require excavation; therefore, road design should done so the amount of earth needing to be removed at the centerline should be optimized to have a smooth slope. Road profile also determines the amount of earth to be cut and filled on the slopes. Since both activities will increase overall road building cost, cut and fill portions should be minimized as much as possible. Road profile also can be determined by a two-man crew using clinometer (abney level) set at zero degree and leveling rod. A person located between two stations having the clinometer set on an eye-level stick will read the numbers on the leveling rod from both directions, sequentially. Back side reading and foresight readings are recorded, and the profile of the road is developed. Figure 3 illustrates the process of collecting data for the road profile. Two simple equations shown in Table 1 are used to determine direction of the road, either uphill or downhill, to get the road profile. Based on data collected, overall slope (grade) of the road is determined.

Figure 1. Schematic of gradeline in the field.

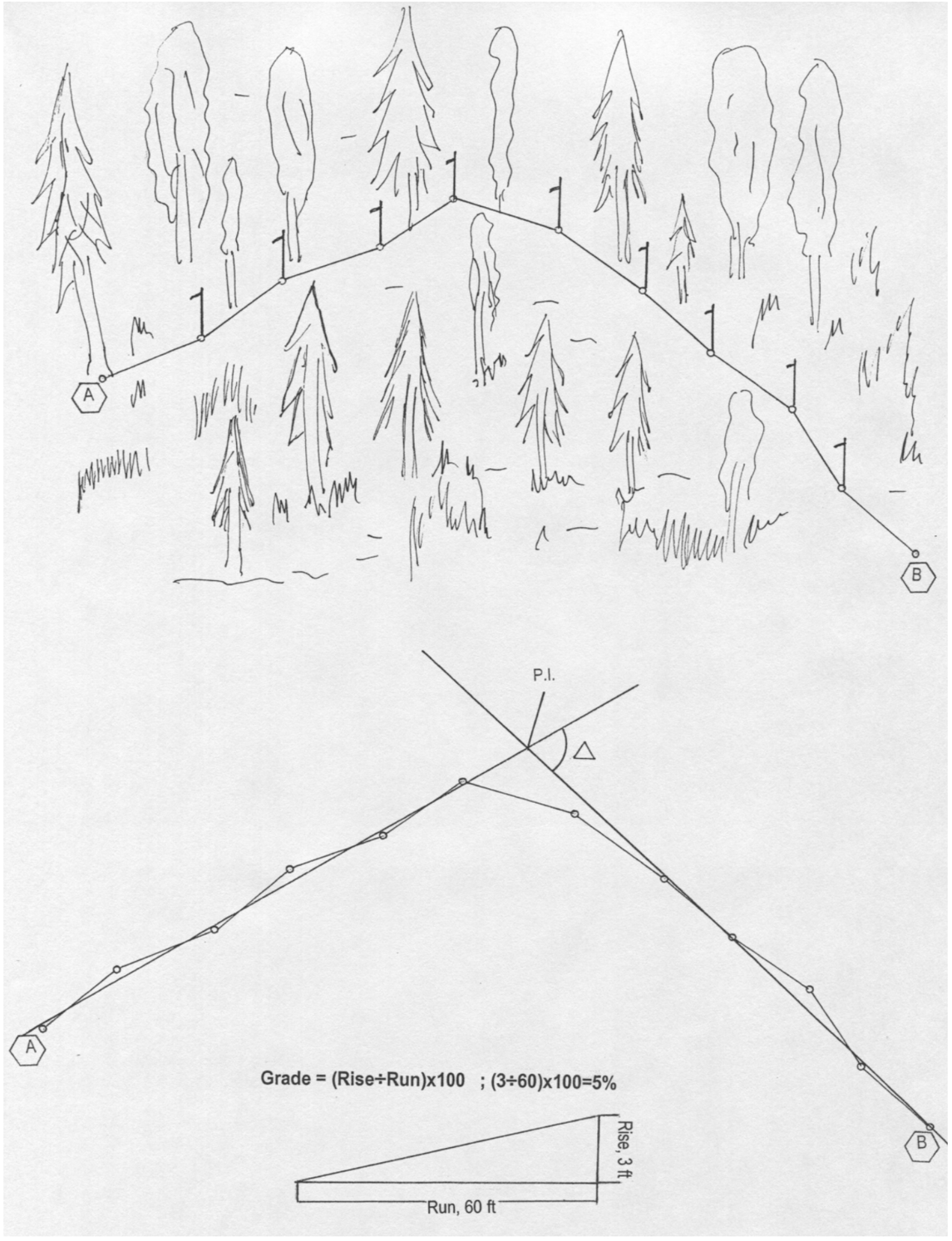

Figure 2. Establishment of centerline and calculations of parameters of the curves.

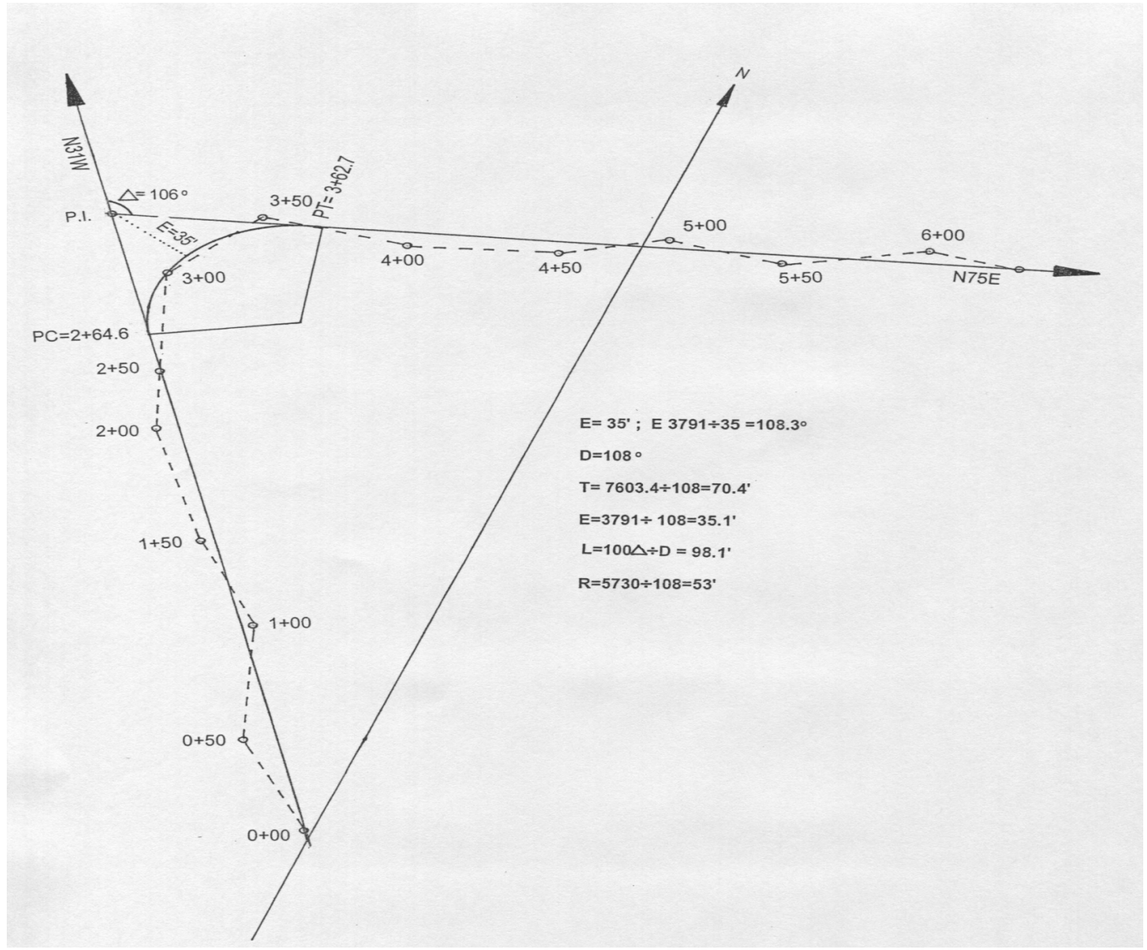

Table 1. Example for road profile. [HI=E+BS; E=HI-FS]

Station	Backsight Reading (BS)	Height of Instrument (HI)	Foresight (FS)	Elevation (E)
0+00	-	-	-	1,000
	5.00	1,005	-	-
0+50	-	-	1.0	1,004
	8.00	1,012	-	-
1+00	-	-	0.5	1,001.5
	7.00	1,018.5	-	-
1+50	-	-	3.00	1,015.5