Table 11-5. The strength of figure

°	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
10	428	359																					
12	359	295	253																				
14	315	253	214	187																			
16	284	225	187	162	143																		
18	262	204	168	143	126	113																	
20	245	189	153	130	113	100	91																
22	232	177	142	119	103	91	81	74															
24	221	167	134	111	95	83	74	67	61														
26	213	160	126	104	89	77	68	61	56	51													
28	206	153	120	99	83	72	63	57	51	47	43												
30	199	148	115	94	79	68	59	53	48	43	40	33											
35	188	137	106	85	71	60	52	46	41	37	33	27	23										
40	179	129	99	79	65	54	47	41	36	32	29	23	19	16									
45	172	124	93	74	60	50	43	37	32	28	25	20	16	13	11								
50	167	119	89	70	57	47	39	34	29	26	23	18	14	11	9	8							
55	162	115	86	67	54	44	37	32	27	24	21	16	12	10	8	7	5						
60	159	112	83	64	51	42	35	30	25	22	19	14	11	9	7	5	4	4					
65	155	109	80	62	49	40	33	28	24	21	18	13	10	7	6	5	4	3	2				
70	152	106	78	60	48	38	32	27	23	19	17	12	9	7	5	4	3	2	2	1			
75	150	104	76	58	46	37	30	25	21	18	16	11	8	6	4	3	2	2	1	1	1		
80	147	102	74	57	45	36	29	24	20	17	15	10	7	5	4	3	2	1	1	1	0	0	
85	145	100	73	55	43	34	28	23	19	16	14	10	7	5	3	2	2	1	1	0	0	0	0
90	143	98	71	54	42	33	27	22	19	16	13	9	6	4	3	2	1	1	1	0	0	0	0
95	140	96	70	53	41	32	26	22	18	15	13	9	6	4	3	2	1	1	0	0	0	0	
100	138	95	68	51	40	31	25	21	17	14	12	8	6	4	3	2	1	1	0	0	0		
105	136	93	67	50	39	30	25	20	17	14	12	8	5	4	2	2	1	1	0	0			
110	134	91	65	49	38	30	24	19	16	13	11	7	5	3	2	2	1	1	1				
115	132	89	64	48	37	29	23	19	15	13	11	7	5	3	2	2	1	1					
120	129	88	62	46	36	28	22	18	15	12	10	7	5	3	2	2	1						
125	127	86	61	45	35	27	22	18	14	12	10	7	5	4	3	2							
130	125	84	59	44	34	26	21	17	14	12	10	7	5	4	3								
135	122	82	58	43	33	26	21	17	14	12	10	7	5	4									
140	119	80	56	42	32	25	20	17	14	12	10	8	6										
145	116	77	55	41	32	25	21	17	15	13	11	9											
150	112	75	54	40	32	26	21	18	16	15	13												
152	111	75	53	40	32	26	22	19	17	16													
154	110	74	53	41	33	27	23	21	19														
156	108	74	54	42	34	28	25	22															
158	107	74	54	43	35	30	27																
160	107	74	56	45	38	33																	
162	107	76	59	48	42																		
164	109	79	63	54																			
166	113	86	71																				
168	122	98																					
170	143																						

use, new construction, tall trees, or other intervening obstructions can make sight lines to proposed or existing stations impossible. Visibility must be checked thoroughly, since any error can cause time-consuming delays when observations begin, possibly disrupting the entire triangulation scheme.

The ability to get materials and equipment to a station location for setting monuments and occupying stations is another important factor. Many triangulation stations require some walking to reach the mark, but this should be kept to a minimum. A station requiring excessive hiking or climbing not only adds an element of danger for surveyors, but also makes the station useless to all but those few willing to assume the extra effort and risk. It is not always possible to avoid inaccessible stations, but the main idea is to make them usable.

The property owner is a principal factor in determining accessibility. If contacted beforehand, the owner will probably permit the vehicular entry of his or her property and explain or show the easiest way to a specific location, in addition to providing keys or combinations to any locked gates.

Permanence of marks is never assured, but many factors should be considered to make their location more reliable. Things to look for include (1) soil condition, (2) possibility of construction or development, (3) farming activities, and (4) changing ownership of private or public land.

Ground condition where a station is placed should be stable. Sand hills, large gravel deposits, and unstable rock outcroppings should be avoided, as well as areas subject to continuous frost action or erosion. Reliability of monuments set in these conditions is greatly diminished owing to the high probability of movement.

Any area subject to proposed development or construction is an unfavorable site for a station, and although it is impossible to guarantee this will not happen, the odds can be greatly increased with a little research. By checking master plans and zoning from the planning agency with jurisdiction over the area, the likelihood of future development can be determined. The topography of an area will also indicate possible future development. In addition, always contact property owners to find out their future plans for the land.

In farming areas, station locations are favorable along a fence line between property owners, near farm buildings, and along groves maintained for shade or wind breaks. Cultivated fields are dangerous since crops may be destroyed every time the station is used, and a surface monument cannot be maintained because of repeated cultivation.

Lands owned by public entities are generally ideal station locations. Locating a monument along the right-of-way fence of established roadways or railroads and within a public park usually ensures its permanence. It is always necessary for property owners to be satisfied with station sites; otherwise, their permanence and availability may be in jeopardy. This policy holds true with a public entity for stations on public land, as well as for private owners.

11-8. SETTING STATION MARKS

After the triangulation net has been established and approved, station monuments are set. Each station should consist of a station mark, at least two reference marks, and one azimuth mark. The azimuth mark may be eliminated if another station is readily visible from the ground.

Station marks, the main monuments from which observations are made, have disks placed both underground and on the surface whenever possible. Both of the bronze disks have the station name and year established stamped on them before being set. The station mark can be set in a concrete monument, boulder, or rock outcropping, or brazed to the end of a pipe positioned in the ground.

The concrete monument is poured in place and consists of a subsurface and surface mon-

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY
NOAA Form 76-52

HORIZONTAL DIRECTIONS

STATION: WYNECOOP OBSERVER: RJH INSTRUMENT: T2 150551 DATE: 4/18/78

POSITION	OBJECTS OBSERVED	TIME H. M.	TEL. D OR R	°	′	MIC. READING 1ST	MIC. READING 2ND	SUM ″	MEAN D AND R	DIRECTION ″	REMARKS
											Rec: C Nelson
1	BALDY (1939)	1640	D	00	00	09	10	19			
			R	180	00	13	13	26	11.2		
	Williams Water Tank (Gray) 3.0 mi NE		D	92	12	46	46	92			
			R	272	12	49	49	98	45.5	34.3	92° 12′
	WYNECOOP RM NO 1 (E) (1972)		D	119	56	21	22	43			
			R	299	56	23	22	45	22.0	10.8	119° 56′
	WYNECOOP RM NO 2 (S) (1972)		D	210	10	55	56	111			
			R	30	10	56	56	112	55.8	44.6	210° 10′
	WYNECOOP AZ MK (SW) (1972)		D	250	12	03	03	06			
			R	70	12	04	05	09	03.8	52.6	250° 11′
2	BALDY		D	45	02	36	37	73			
			R	225	02	39	39	78	37.8		
	Williams Water Tank		D	137	15	16	16	32			
			R	317	15	16	16	32	16.0	38.2	92° 12′
	RM NO 1		D	164	58	44	45	89			
			R	344	58	46	46	92	45.2	07.4	119° 56′
	RM NO 2		D	255	13	20	20	40			
			R	75	13	21	21	42	20.5	42.7	210° 10′
	AZ MK		D	295	14	33	32	65			
			R	115	14	35	34	69	33.5	55.7	250° 11′
											✓RJH

Figure 11-9. Observation of marks and intersection stations.

—should be described completely, including the structure's local name and description of the part observed, approximate distance from the occupied station, and bearing (E, NE, etc.) from the occupied station. Beginning and ending times for each position are entered under the time head in the third column, using military time from 0000 (midnight) to 2359.

The fourth column describes the telescope position—D for direct or R for reverse—followed by the direction observed with two micrometer readings taken for each position (see Section 11-11-3). The sum of the micrometer readings is entered under the sum heading while the mathematical mean, to the nearest 0.1 sec, is noted in the following column, under mean. When using the Wild T-3 theodolite, the sum of the two direct micrometer readings and that of the two reverse micrometer readings are meaned. On the Wild T-2 and other comparable directional theodolites, the entry is the mean of all four micrometer readings. Seconds of direction observed from the initial station to each object are entered under "direction" (subtract the mean of initial from the mean of observed).

All pertinent information discussed earlier is entered under remarks. Degrees and minutes of direction observed from the initial station are also listed under this column for each direction observed.

After observations of marks and intersecting stations are completed, observations of the main and supplemental scheme begin (Figure 11-9). Recording main and supplementary observations is done in the same manner as for mark and intersecting station observations. Reobservations are entered after the original set. When the theodolite is checked for level, it should be recorded under remarks and any adjustment noted.

After each page or set of observations is recorded, it must be completely reviewed, all items checkmarked, and each page initialed, and corrections also checked and initialed. Entries must be in ink, and no erasures are permitted. Errors are deleted by a single line through the incorrect entry and the correction placed above the deletion. When filled, an alphabetized index is recorded in the front of the book.

11-10-3. Observations of Double Zenith Distances

Typical recordings for vertical angles or double zenith distances observed as given in Figure 11-11 are self-explanatory.

11-10-4. Abstracts

After each set of horizontal distances and zenith distances has been observed and the field book checked, an abstract is recorded to make certain all observations are within required tolerances. Abstracts should be completed in ink, without erasures.

The "abstract of directions" (Figure 11-12) lists all observations taken directly from the "horizontal directions" book, except those taken on a wrong object or any resulting from a kicked tripod, which are rejected immediately in the book. Any observation so far from the apparent mean as to be considered a blunder may be rejected before calculating the initial mean. Once all observations have been entered on the abstract, the columns are summed and a mean angle is derived. Any observation outside the required tolerance is rejected. That position is then reobserved and the new observation entered on the abstract. The mean of the observations is recalculated using the new observation. If, when we use the new mean, the rejected observation and new observation both fall within the required tolerance, they are meaned and used as the observed seconds for that position. A rejected observation still outside required tolerance is enclosed in parentheses and an R written behind, meaning that it is rejected and not used to calculate the mean direction.