MISCELLANEOUS PAPER 90

MARCH 1960

Roof-Purlin Spacing for Multicombination Pole-Type Construction

L. W. BONNICKSEN

AGRICULTURAL EXPERIMENT STATION • OREGON STATE COLLEGE • CORVALLIS

ROOF-PURLIN SPACING FOR MULTICOMBINATION POLE-TYPE CONSTRUCTION

L. W. Bonnicksen*

The information in this paper is an expansion of the information in Station Bulletin 557, "Multicombination Pole-Type Construction." This additional information describes a method of spacing 2 x 6 purlins every two feet measured horizontally.

Features of this method of purlin spacing are:

It is standardized so that -

- it is compatible with many shapes as shown in the next two pages.
- a combination of 7-, 9-, or 11-foot lengths of roof sheets will fit any roof width.

The outside roof purlin can be set vertical. Thus it can -

- be fastened directly to the outer pole.
- provide a base for an eave trough.

The outside roof purlin can have the siding nailed to it, thus -

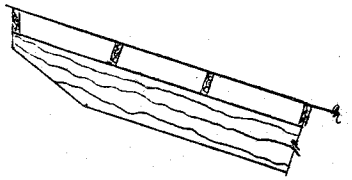
- eliminating the top wall girt.
- completely covering the outside purlin and end of the rafters.
- giving better overall building bracing by the joining of the sidewall and roof diaphragms.

It can be adapted to other types of roof construction, such as -

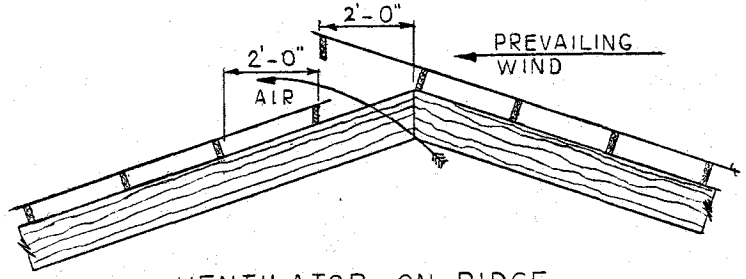
- other slopes
- other purlin sizes
- other purlin systems
- other horizontal spacings

Page 4 is a table of the strength of these purlins in terms of allowable total loads, snow loads and wind velocities.

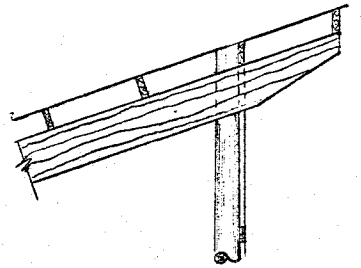
*Assistant Agricultural Engineer



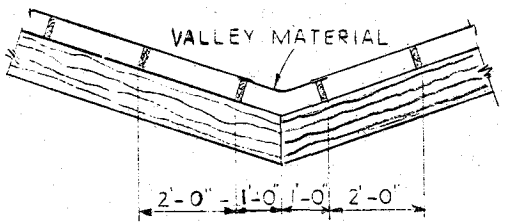
OVERHANGING EAVE



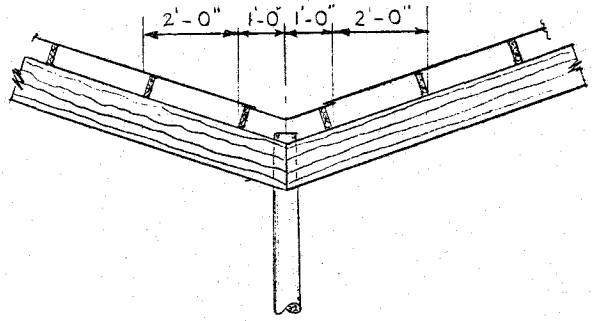
VENTILATOR ON RIDGE



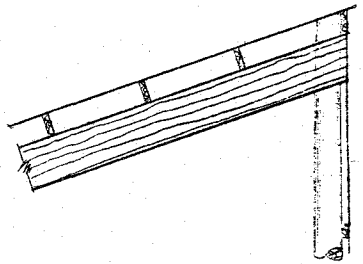
OUTER POLE
OVERHANGING EAVE



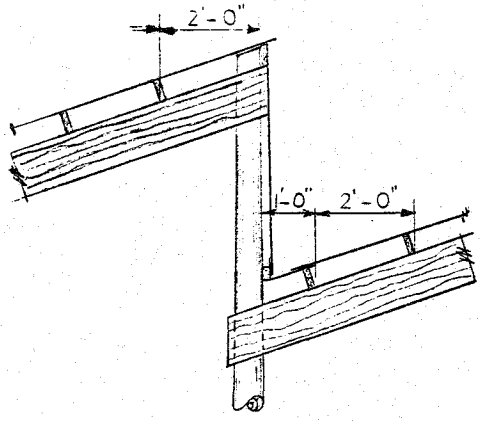
VALLEY



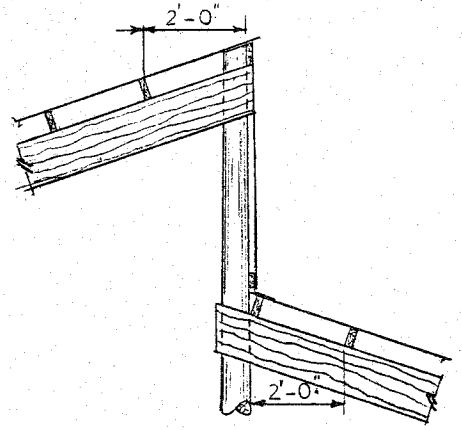
VALLEY POLE



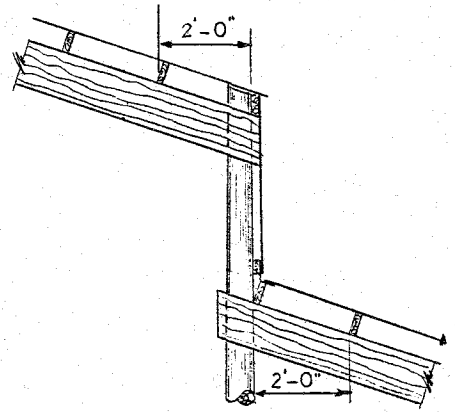
OUTER POLE
FLUSH EAVE



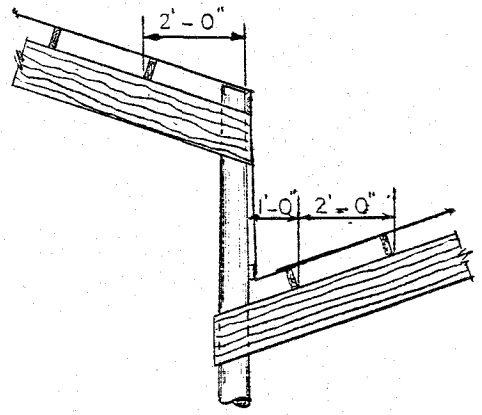
SAW TOOTH



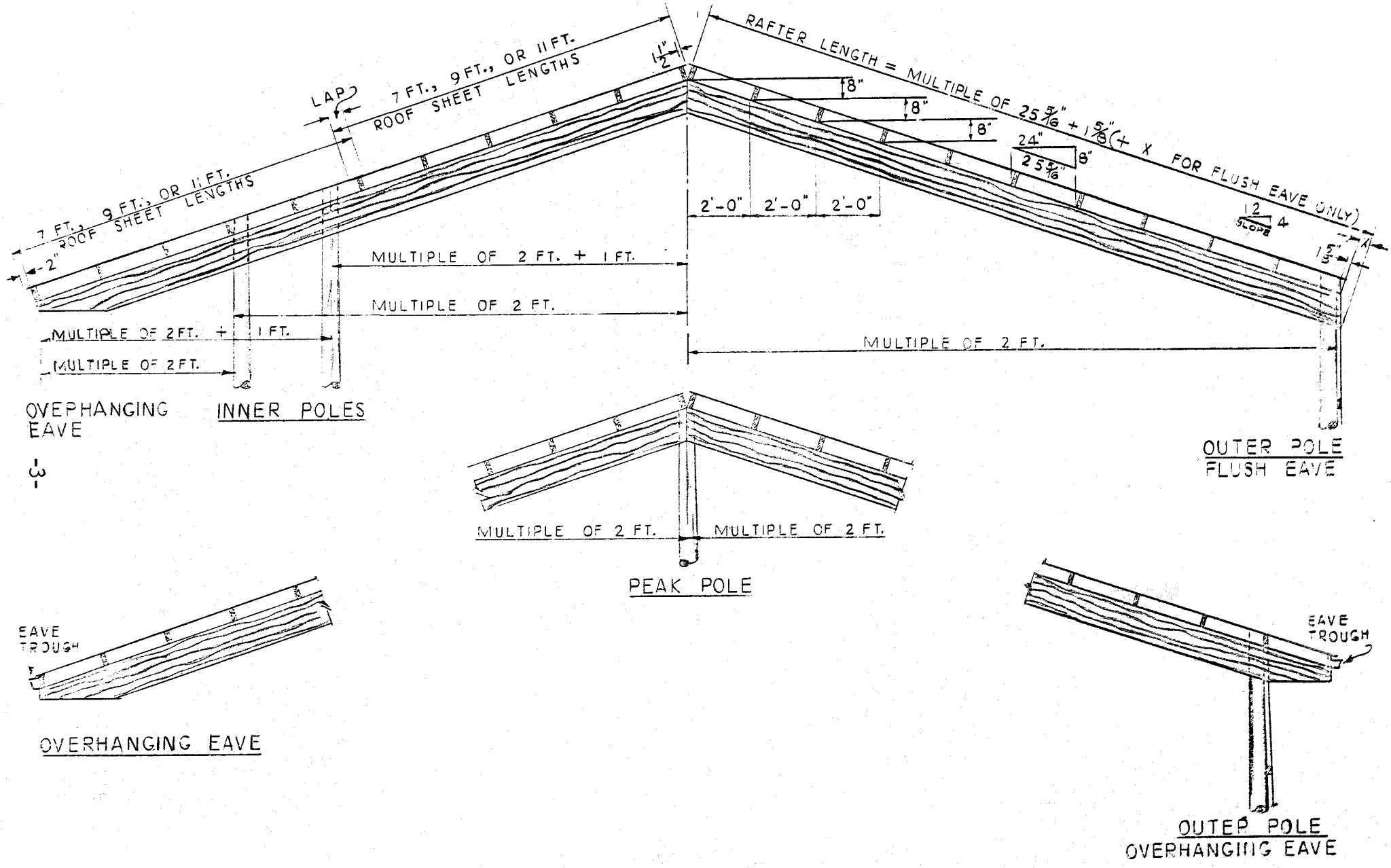
HALF MONITOR



MONITOR



STAGGERED VALLEY


LAP
7 FT., 9 FT., OR 11 FT.
ROOF SHEET LENGTHS
1½"
RAFTER LENGTH = MULTIPLE OF 25 5/16" + 1 5/8" (+ X FOR FLUSH EAVE ONLY)
8"
8"
8"
24"
8"
25 5/16"
2'-0"
2'-0"
2'-0"
12 SLOPE 4
1 5/8"
2"
MULTIPLE OF 2 FT. + 1 FT.
MULTIPLE OF 2 FT.
MULTIPLE OF 2 FT. + 1 FT.
MULTIPLE OF 2 FT.
MULTIPLE OF 2 FT.
OVEPHANGING EAVE
INNER POLES
OUTER POLE
FLUSH EAVE
MULTIPLE OF 2 FT.
MULTIPLE OF 2 FT.
PEAK POLE
EAVE TROUGH
OVERHANGING EAVE
EAVE TROUGH
OUTER POLE
OVERHANGING EAVE

ALLOWABLE TOTAL LOADS, SNOWLOADS AND WIND VELOCITIES ON ROOF PURLINS

OF 2 X 6 DOUGLAS FIR JOIST AND PLANKS WITH A 4 ON 12 SLOPE

DEAD LOAD = 2.1 lb/ft.² (2 8 ga. Steel, 2X6 Purlins)

ALLOWABLE LOAD = $\frac{(2.878)(f)(\text{increase Factor})}{(\text{Clear Span})^2}$

(1.053 Increase Factor due to slope is included in above formula.)

				FARM ECONOMY (WHEN FAILURE WILL NOT ENDANGER HUMAN LIFE) 1.33 INCREASE				SAFE (WHEN FAILURE MAY ENDANGER HUMAN LIFE) NO INCREASE					
				2X6 X 14 FT. PURLINS 13.3 FT. CLEAR SPAN		2X6 X 16 FT. PURLINS 15.3 FT. CLEAR SPAN		2X6 X 12 FT. PURLINS 11.3 FT. CLEAR SPAN		2X6 X 14 FT. PURLINS 13.3 FT. CLEAR SPAN		2X6 X 16 FT. PURLINS 15.3 FT. CLEAR SPAN	
TYPE OF ALLOWABLE LOAD	UNITS (Action of Dead Load)	DURATION	INCREASE FACTOR	CONST. 1500 f	STD. 1200 f	CONST. 1500 f	STD. 1200 f	CONST. 1500 f	STD. 1200 f	CONST. 1500 f	STD. 1200 f	CONST. 1500 f	STD. 1200 f
TOTAL LOAD	lbs/Horz. ft² (INCLUDES DEAD LOAD)	10-YR.	0	32.42	25.9	24.52	19.61	33.80	27.04	24.40	19.52	18.44	14.75
SNOW LOAD	lbs/Horz. ft² (DEAD LOAD OF 2.1 lb/ft² HAS BEEN SUBTRACTED)	2-MO.	1.15	35.3	27.7	26.1	20.5	35.7	29.0	26.0	20.3	19.1	14.9
		1-WK.	1.25	38.4	30.3	28.6	22.4	40.1	31.7	28.4	22.3	21.0	16.3
WIND WINDWARD SIDE OF BUILDING 30% OR MORE OPEN → q=-2.1 (OPEN / CLOSED)	miles per hour (DEAD LOAD OF 2.1 lb/ft² HAS BEEN ADDED)	1-DAY	1.33	88	78	75	67	93	85	75	67	65	57
		1-HR.	1.49	93	83	80	71	98	89	80	71	69	60
		5-MIN.	1.63	99	87	84	74	103	91	84	74	72	65
		1-MIN.	1.74	100	89	87	77	107	95	87	77	74	65
WIND WINDWARD SIDE OF BUILDING CLOSED q = -1.5 (CLOSED → / OPEN OR CLOSED)	miles per hour (DEAD LOAD OF 2.1 lb/ft² HAS BEEN ADDED)	1-DAY	1.33	104	92	89	78	111	100	89	78	76	67
		1-HR.	1.49	111	98	95	84	117	106	95	84	81	73
		5-MIN.	1.63	116	103	100	88	122	110	100	88	85	75
		1-MIN.	1.74	119	106	103	92	125	113	103	92	88	77

DEFLECTION AT CENTER OF PURLIN SPAN

SPAN	TOTAL LOAD W lb/HORIZ. ft²	2.1	5	10	15	20	25	30	35	40	W
2X6 X 12 FT. PURLINS (11.3 ft. Clear)	DEFLECTION	.035	.08	.16	.25	.33	.41	.49	.58	.66	.0165 W
	DEFLECTION / SPAN	1/3900	1/1650	1/824	1/550	1/410	1/330	1/274	1/235	1/205	
2X6 X 14 FT. PURLINS (13.3 ft. Clear)	DEFLECTION	.07	.16	.32	.47	.63	.79	.95	1.10	1.26	.0316 W
	DEFLECTION / SPAN	1/2400	1/1000	1/500	1/340	1/250	1/230	1/170	1/145	1/125	
2X6 X 16 FT. PURLINS (15.3 ft. Clear)	DEFLECTION	.12	.28	.55	.83	1.11	1.38	1.66	1.94	2.21	.0553 W
	DEFLECTION / SPAN	1/1580	1/660	1/330	1/220	1/166	1/133	1/111	1/95	1/83	

$$\text{DEFLECTION} = \frac{W(\text{PURLIN SPACING})(L)^4}{E\,I\,(\text{SLOPE INCREASE FACTOR})} = \frac{(5)(W\ \text{lb/ft}^2)(2\text{ ft})(L\text{ ft.})^4(1728\ \text{in}^3/\text{ft}^3)}{(584)(1{,}760{,}000\ \text{lbs/in}^2)(24.1\ \text{in}^4)(1.053)}$$