Mad River Flash

Well the summer is slowly grinding down and I hope you have all your antenna projects completed. I have heard from a few of you this summer and it seems that some big antenna projects have been planned. Ron-K8NZ is moving some antennas and doing some maintenance to the KLM 40. (That has a familiar ring to it). Ron believes that this work will help his group beat us in the ARRL DX TEST in February. I know it will help him in the CQWW but he may as well give up for ARRL.

I got a letter from Jeff-K8ND and he is doing all sorts of antenna work plus RTTY. He's also doing maintenance on the KLM-40.

Dean-WB8WMB just completed a big project this week also. A new 100' self supporting tower was installed and we put a 5 el 20 and a 6 el 15 on top so that's the major portion of the work accomplished for this year. The 80 meter system needs some changing along with a new hardline run but that shouldn't be much of a problem.

Last weekend I was at Randy's-W8FN where Dean, Randy and myself installed a host of new aluminum. In addition to the existing 2 el 40 we removed the TH6 DXX (for use at Dean's) and replaced it with a KLM 6 el 10. On a separate tower we put a 4 el 15 and a 4 el 20 (Cash Craft and Hy-gain). Randy has everything working except 80 and 160 verticals so he is going hot and heavy into the contest season this year.

I see where "Doc" KN8Z (ex WA8ZDF) is back on the air in a small way. 3 el 40, 5 el 20, 5 el 15, 5 el 10 all over 100'. He has TR7, R7, Alpha 77 so let's all hear it for "a small way."

I only received 1 letter in response to the last flash. That's pretty good I guess. It could have been worse. If mom had not sent that one letter .....

I saw the newsletter from Ill-Wind and Jeff's response to it. It's really to bad that these guys in 9 land feel so bad. They think we are no longer competetion for them in S.S. Well I certainly would like to shove their noses in horse manure. Even if they aren't openly challenging us, let's put a super effort in and beat the hell out of them. Listen, if I can pick up a microphone and turn in 100K then anybody can. I will go out on a limb and say that I will promise 100,000 points each mode. How about you other members? If everybody that receives this flash would put in an effort to get 100,000 points each mode we would have a total score of over 12,000,000. That's not too shabby for a medium club score.

Coming up in a couple weeks is our next meeting. It is at Findlay at the hamfest. The meeting will be at 12:00 noon in the only meeting room at the facility so bring your pictures and papers and be prepared to exchange a few lies and war stories.

WB8VPA has gracious offered to supply me with address labels. All I need to do is get the list to him. Well, I'm still trying.

As this is being prepared I'm making plans for the All Asia test. It will be a good time to try the 15 meter beam out at Dean's.

I talked to K3LR and it sounds like they had quite good conditions during Field Day. Something like 12,000 points in 3A. Hope you have a winner Tim.

I operated from KN8S where I think we had about 1,200 QSO's. If my memory serves me correct we had about 65% CW in 1A.

I will put some mast calculations in this issue if I can remember to do so. Just don't yell if I happen to forget. Randy was nice enough to supply the mathematics for it because I have trouble adding and subtracting. If you are planning stacking antennas on one mast this will be very helpful to you.

Well I'd better get this in the mail. Remember the sked on Monday nights at 8:30 local time on 3825. My golf season has come to a halt so I should be on every night.

73's

Bill

ANTENNA MAST ANALYSIS

FOR A CYLINDRICAL MEMBER, THE STRESS ON THE OUTERMOST FIBER IS GIVEN BY:

$f = \frac{M}{S}$, WHERE M IS THE APPLIED BENDING MOMENT AND S IS THE SECTION MODULUS

S IS DETERMINED BY THE SHAPE OF THE MEMBER AND FOR A HOLLOW CYLINDER IS GIVEN BY:

$$S = \frac{\pi \left[R_2^4 - R_1^4\right]}{4R_2} \quad (in^3)$$

IF R_2, R_1 IN INCHES, S HAS UNITS OF in^3

THE BENDING MOMENT, M, IS DETERMINED BY ADDING THE TOTAL MOMENT CONTRIBUTIONS AT THE LOWER (TOWER) END OF THE MAST DUE TO THE WIND LOADS OF BOTH ANTENNAS AND THE MAST ITSELF.

FOR THE KLM 13.9-14.4-5A, SPECIFIED WIND LOADING IS $9.3\ ft^2$ AND BOTH ANTENNAS WILL BE ASSUMED TO HAVE THIS LOADING. FOR A $30\ lb/ft^2$ WIND PRESSURE (86.6 MPH), EACH ANTENNA WILL THUS EXERT A FORCE OF $9.3\ ft^2 \times 30\ lb/ft^2 = 279\ lb$.

THE TOP ANTENNA WILL THUS PRODUCE A BENDING MOMENT (FORCE X MOMENT ARM) OF $279 \times L$ ft-lb, WHERE L IS THE DISTANCE ABOVE TOWER TOP (LENGTH OF MAST).

THE LOWER ANTENNA WILL BE ASSUMED TO BE 1 ft ABOVE TOWER TOP, SO ITS MOMENT CONTRIBUTION IS 279×1 ft-lb.

FOR A CYLINDRICAL SHAPE SUCH AS THE MAST, THE EFFECTIVE WIND LOADING AREA IS TAKEN AS .6 TIMES THE PROJECTED AREA OF THE MAST. HENCE, IF WE ASSUME A MAST MADE FROM 1½" PIPE WITH AN OUTSIDE DIAMETER OF 1.9 in, THE WIND LOADING AREA IS THUS $.6\left(\frac{1.9\ in}{12\ in/ft}\right) L\ ft = \frac{1.9L}{20}\ ft^2$

THE WIND FORCE ON THE MAST IS THUS $\frac{1.9L}{20}\ ft^2 \times 30\ \frac{lb}{ft^2} = \frac{3(1.9)L}{2}\ lb = 2.85L\ lb$

THIS DISTRIBUTED FORCE WILL PRODUCE A BENDING MOMENT EQUIVALENT TO A SINGLE FORCE ACTING AT L/2, HENCE THE MOMENT CONTRIBUTION OF THE MAST IS $2.85L \times \frac{L}{2} = 1.425L^2$ ft-lb

WE CAN NOW USE THE TOTAL MOMENT CONTRIBUTION TO SOLVE FOR MAXIMUM MAST LENGTH L.

THE TOTAL MOMENT CONTRIBUTION FROM ANTENNAS AND MAST IS:

$$M = 1.425L^2 + 279L + 279 \quad \text{ft·lb}$$

THIS QUADRATIC IN L CAN BE SOLVED TO FIND THE MAST LENGTH L CORRESPONDING TO SOME PARTICULAR BENDING MOMENT M.

TO DETERMINE THE MAST LENGTH WHICH WILL CAUSE THE MAST TO BEND, WE MUST FIND THE MOMENT M CORRESPONDING TO A STRESS SUFFICIENT TO CAUSE FAILURE OF THE MAST. THIS OCCURS FOR A STEEL MAST WHEN THE STRESS IS ABOUT 40,000 lb/in².

SO, SINCE $f = \frac{M}{S}$ WE CAN SOLVE $M = f \times S = 40000 \frac{\text{lb}}{\text{in}^2} \times S\,\text{in}^3 = 40000\,S$ in-lb

CONVERTING THIS MOMENT TO ft·lb: $M = \frac{40000\,S \text{ in-lb}}{12 \text{ in/ft}} = \frac{40000S}{12}$ ft·lb

SO AT MAST FAILURE, WE HAVE:

$$\frac{40000S}{12} = 1.425L^2 + 279L + 279$$

THEN $1.425L^2 + 279L + \left[279 - \frac{40000S}{12}\right] = 0$, WHICH CAN BE SOLVED FOR L USING THE QUADRATIC FORMULA

PUTTING THE EQUATION IN THE FORM $aL^2 + bL + C = 0$

$$L = \frac{-b}{2a} + \frac{1}{2a}\sqrt{b^2 - 4ac}$$

(THE SECOND ROOT INVOLVING $-\frac{1}{2a}\sqrt{b^2-4ac}$ IS SUPERFLUOUS)

THIS LENGTH L CORRESPONDS TO THE <u>ABSOLUTE MAXIMUM</u> LENGTH L IN FEET ABOVE THE TOWER FOR A 30 lb/ft² WIND SURVIVAL.

EXAMPLE CALCULATIONS:

1. WHAT IS MAXIMUM LENGTH OF MAST MADE OF $1\frac{1}{2}$" SCHEDULE 80 PIPE (1.9" O.D., .2" WALL) FOR 30 lb/ft² WIND SURVIVAL?

FOR THIS PIPE $R_2 = 1.9/2 = .95"$ & $R_1 = .95 - .20 = .75"$

SO $$S = \frac{\pi\left[.95^4 - .75^4\right]}{4(.95)} = .412$$

SO WE MUST SOLVE $$1.425L^2 + 279L + \left[279 - \frac{40000(.412)}{12}\right] = 0$$

SO $$1.425L^2 + 279L - 1093.66 = 0$$

AND $$L = \frac{-279}{2.85} + \frac{1}{2.85}\sqrt{279^2 + 4(1.425)(1093.66)} = -97.89 + 101.74 = \underline{3.84 \text{ ft}}$$

SCHEDULE 80 PIPE CLEARLY WILL NOT WORK!

2. HOW ABOUT $1\frac{1}{2}$" DOUBLE EXTRA HEAVY (1.9" O.D., .4" WALL)?

$R_2 = .95$, $R_1 = .55$ → $S = .598$

$$1.425L^2 + 279L + \left[279 - \frac{40000(.598)}{12}\right] = 0$$

$$1.425L^2 + 279L - 1713.43 = 0$$

$$L = \frac{-279}{2.85} + \frac{1}{2.85}\sqrt{279^2 + 4(1.425)(1713.43)} = -97.89 + 103.86 = \underline{5.96 \text{ ft}}$$

SO $1\frac{1}{2}$" DOUBLE EXTRA HEAVY CAN BE USED IF 5 FOOT STACKING SEPARATION IS ACCEPTABLE (i.e., LOWER ANTENNA AT 1' AND TOP ANTENNA AT 6' ABOVE TOWER TOP)