The Numerical Analysis for Jump Height of Multi-two-spans Ice-shedding at Different Time Intervals of Overhead Transmission Line

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Abstract

According to different parameters of transmission line such as spans, span length, ice thickness, a finite element analysis model of wire-insulator was established, and the simulation of ice-shedding from overhead transmission line was adopted by additional force method. Then, the jump height of multi-two-spans at different time intervals can be got.

I . NUMERICAL SIMULATION METHOD ON ICE-SHEDDING OF OVERHEAD LINE

A. Wires-insulator finite element analysis model

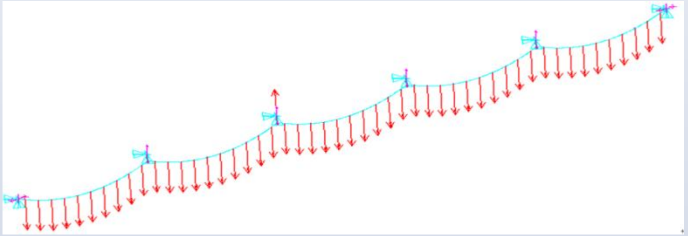


Figure 1: Finite element model of conductor-insulator

B. The FEA process of the ice-shedding process

(1) The transmission line form finding, catenary equilibrium calculation of overhead transmission line in operation under the action of self weight and tension;

(2) The catenary equilibrium calculation overhead line with ice loads;

(3) The ice cover in the overhead line at a certain time is detached in some form, and the process is mainly simulated by the additional concentrated load method, the element birth and death method or the changing density method.;

(4) The response of the tower line after the ice-shedding.

C. Overhead transmission line finite element form finding(Figure 2)

D. Calculation of additional force (Figure 3)

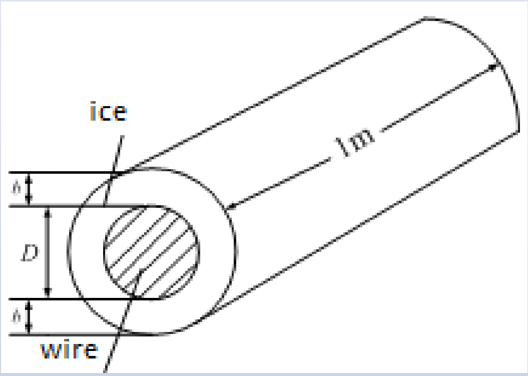


Figure 3: Calculation of ice thickness

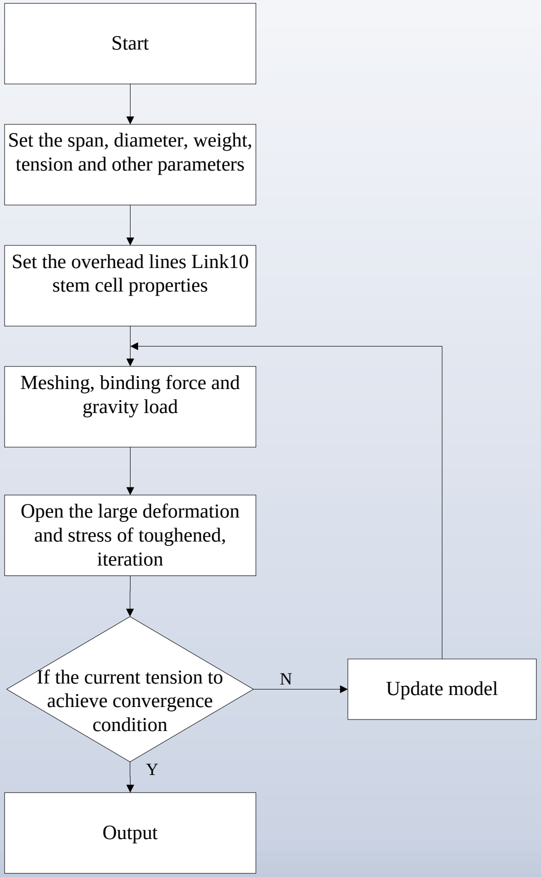
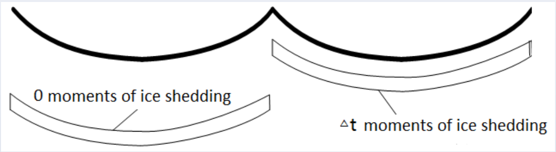
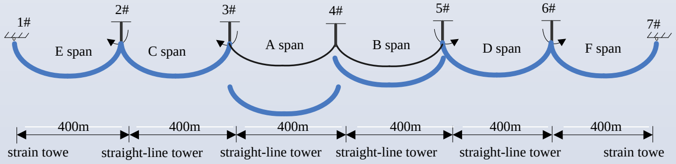


Figure 2: Basic steps of overhead line finite element form finding

II. THE EFFECT OF THE DIFFERENT TIME INTERVALS FOR TWO-SPAN ICE-SHEDDING JUMP HEIGHT





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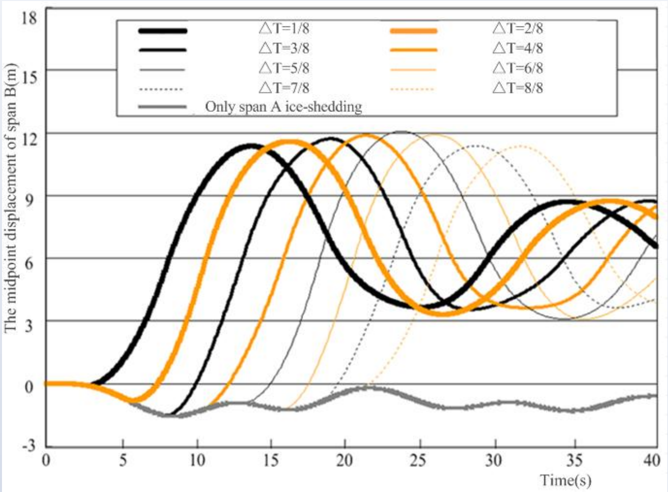


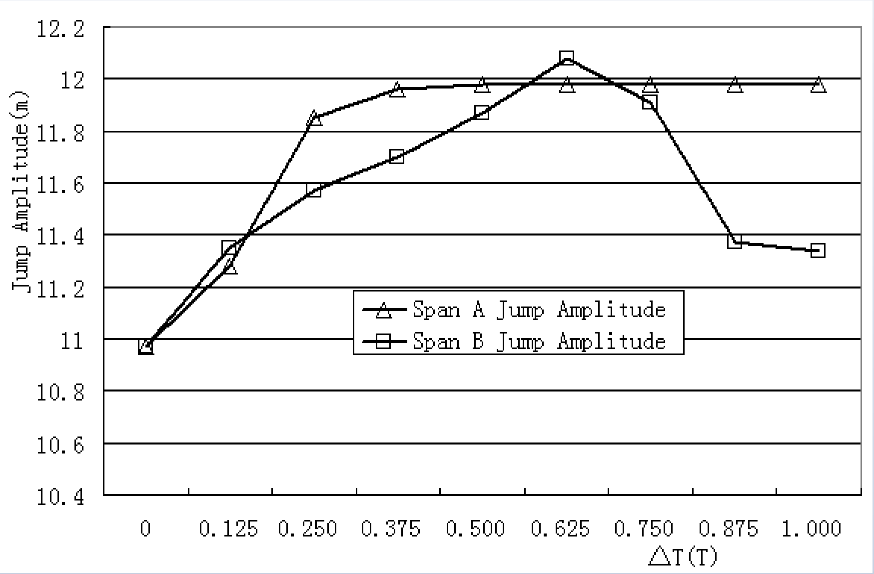
Figure 4: The way at different intervals times for adjacent two-span ice-shedding on overhead line

Figure 5: Transmission line with 7 tower and 6 span

Figure 6: Time history of displacement responses at midpoints of span B for two-span assembling ice-shedding

Table 1: Ice jump amplitude of two-span ice-shedding at different times

ΔT (T)	A jump amplitude (m)	B jump amplitude (m)	B > A
0	10.97	10.97	
1/8	11.28	11.35	
2/8	11.85	11.57	
3/8	11.96	11.70	
4/8	11.98	11.87	
5/8	11.98	12.08	YES
6/8	11.98	11.91	
7/8	11.98	11.37	
8/8	11.98	11.34	



III. ANALYSIS OF THE INFLUENCE FACTORS IN TWO-SPAN ICE-SHEDDING JUMP HEIGHT

A. Impact of ice weight for two-span ice-shedding jump height

ΔT (T)	Icing thickness (mm)	A jump amplitude (m)	B jump amplitude (m)	B > A
0	10	7.4	7.4	
4/8	10	8.35	8.19	
5/8	10	8.35	8.21	
6/8	10	8.35	8.02	
0	15	10.98	10.98	
4/8	15	12.04	11.87	
5/8	15	12.04	12.08	YES
6/8	15	12.04	11.91	
0	20	14.2	14.2	
4/8	20	15.28	15.03	
5/8	20	15.28	15.54	YES
6/8	20	15.28	15.51	YES

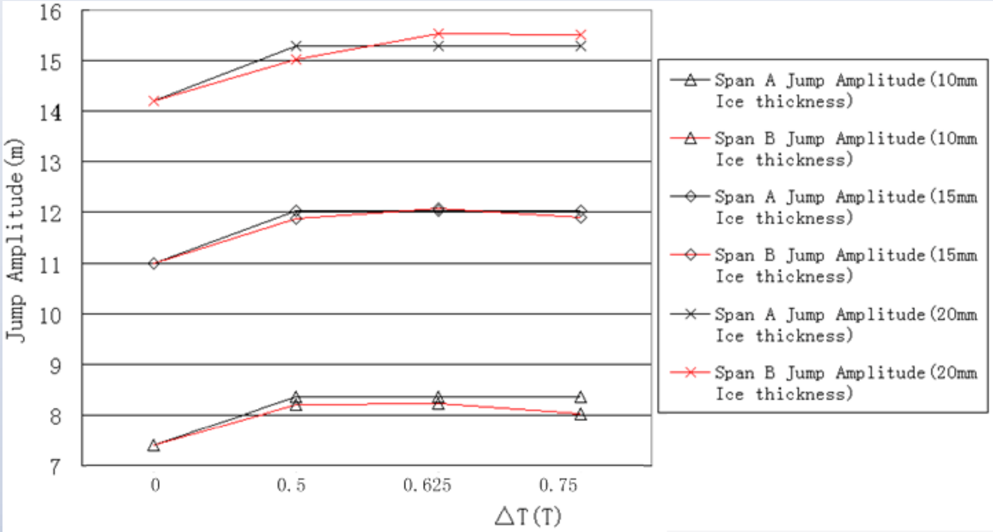


Table 2 Ice jump amplitude of two-span ice-shedding at different ice weight

B. Impact of span length for two-span jump height

ΔT (T)	span length(m)	A jump amplitude(m)	B jump amplitude(m)	B > A
0	300	6.94	6.94	
4/8	300	7.55	7.44	
5/8	300	7.55	7.61	YES
6/8	300	7.55	7.52	
0	400	10.98	10.98	
4/8	400	12.04	11.87	
5/8	400	12.04	12.08	YES
6/8	400	12.04	11.91	
0	500	15.21	15.21	
4/8	500	17.12	16.63	
5/8	500	17.12	16.81	
6/8	500	17.12	16.53	

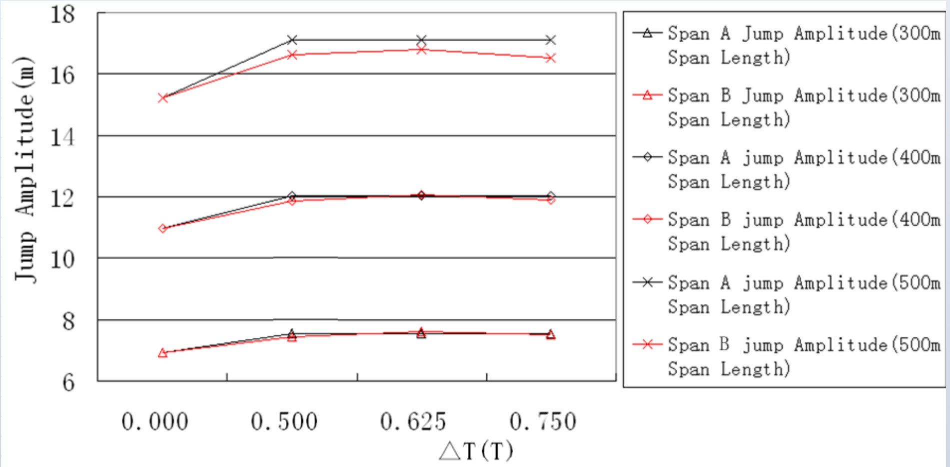


Table 3: Ice jump amplitude of two-span ice-shedding at different span length

C. Impact of spans for two-span ice-shedding jump height

ΔT (T)	spans (m)	A jump amplitude(m)	B jump amplitude(m)	B > A
0	4	10.01	10.01	
4/8	4	11.66	11.29	
5/8	4	11.66	11.48	
6/8	4	11.66	11.15	
0	6	10.98	10.98	
4/8	6	12.04	11.87	
5/8	6	12.04	12.08	YES
6/8	6	12.04	11.91	
0	8	11.33	11.33	
4/8	8	12.2	12.09	
5/8	8	12.2	12.29	YES
6/8	8	12.2	12.14	

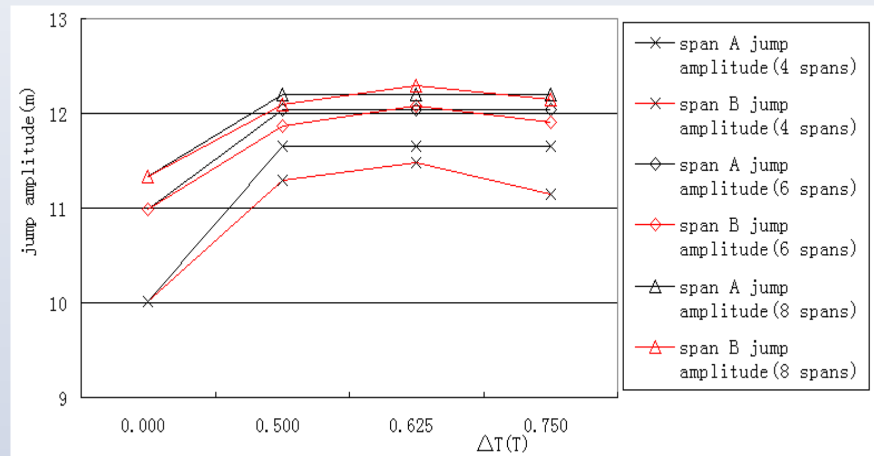


Table 4: Ice jump amplitude of two-span ice-shedding at different spans

D. Impact of height difference for two-span ice-shedding jump height

ΔT (T)	height difference(m)	A jump amplitude(m)	B jump amplitude(m)	B > A
0	0	10.98	10.98	
4/8	0	12.04	11.87	
5/8	0	12.04	12.08	YES
6/8	0	12.04	11.91	
0	40	11.26	11.26	
4/8	40	11.96	11.59	
5/8	40	11.96	11.68	
6/8	40	11.96	11.44	

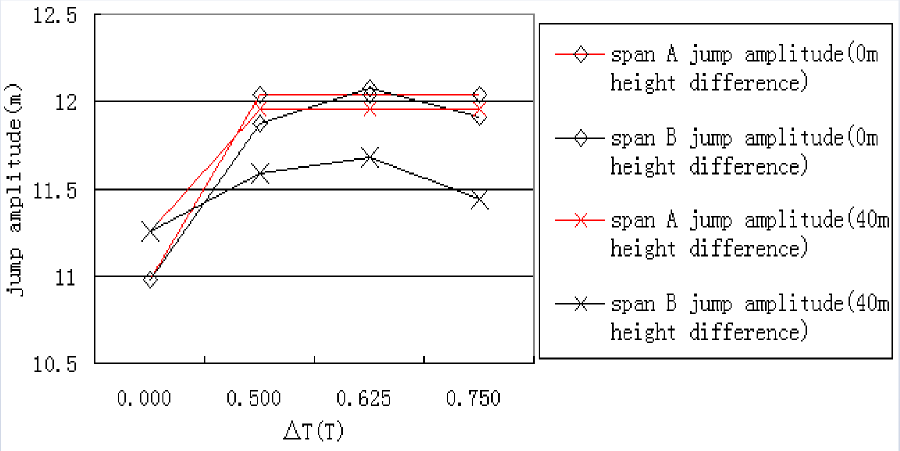


Table 5: Ice jump amplitude of two-span ice-shedding at different height difference

E. Impact of damp coefficient for two-span ice-shedding jump height

ΔT (T)	damp	A jump amplitude(m)	B jump amplitude(m)	B > A
0	0.02	12.61	12.61	
4/8	0.02	13.76	13.88	YES
5/8	0.02	13.76	14.53	YES
6/8	0.02	13.76	14.26	YES
0	0.06	11.74	11.74	
4/8	0.06	12.84	12.806	
5/8	0.06	12.84	13.17	YES
6/8	0.06	12.84	12.95	YES
0	0.1	10.98	10.98	
4/8	0.1	12.04	11.87	
5/8	0.1	12.04	12.08	YES
6/8	0.1	12.04	11.91	

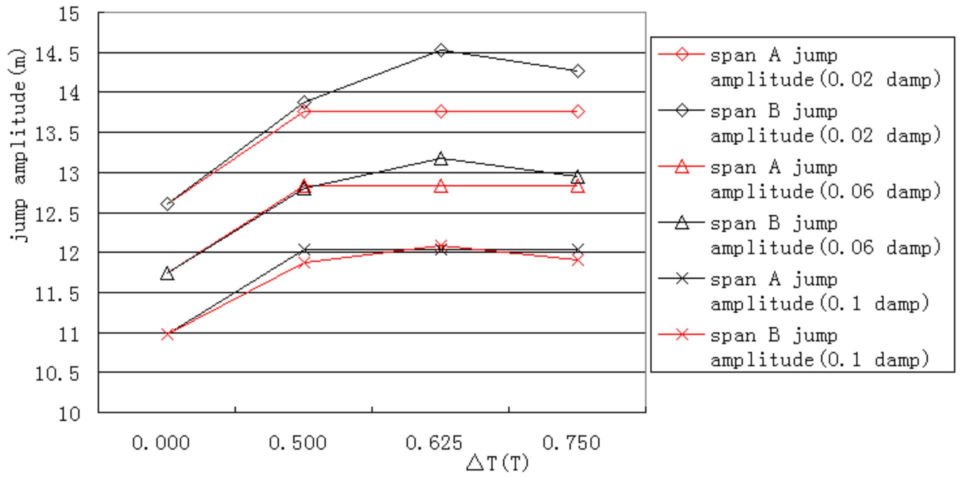


Table 6: Ice jump amplitude of two-span ice-shedding at different damp

CONCLUSION

The result shows that the amplitude of jump height decreased when the same time of ice-shedding on multi-two-spans which effect was equivalent to unilateral strain tower. The amplitude of previous ice-shedding spans is easily exceeded by the later spans when the vibration cycle of multi-two-spans interval was about 5/8. Besides, it was great impact on spans coupling such as the weight of the ice, spans, span length, damp and other factors. When the mass of the ice and spans is larger, the jump height of previous ice-shedding spans can easily passed by the later spans, but the effect of damp, span length is just the opposite.

THANK YOU FOR YOUR ATTENTION!