3 Blade Aerodynamic Properties

Similar to the blade structural properties, we based the blade aerodynamic properties of the NREL 5-MW baseline wind turbine on the DOWEC blades (using the data described in Table 1 on page 13 of Ref. [14] and in Appendix A of Ref. [17]). We set the FAST with AeroDyn and ADAMS with AeroDyn models to use 17 blade elements for integration of the aerodynamic and structural forces. To better capture the large structural gradients at the blade root and the large aerodynamic gradients at the blade tip, the 3 inboard and 3 outboard elements are two-thirds the size of the 11 equally spaced midspan elements. Table 3-1 gives the aerodynamic properties at the blade nodes, which are located at the center of the blade elements.

The blade node locations, labeled as "RNodes" in Table 3-1, are directed along the blade-pitch axis from the rotor center (apex) to the blade cross sections. The element lengths, "DRNodes," sum to the total blade length of 61.5 m indicated in Table 2-2. The aerodynamic twist, "AeroTwst," as given in Table 3-1, are offset by −0.09182° from the values provided in Appendix A of Ref. [17] to ensure that the zero-twist reference location is at the blade tip. Integrating the chord distribution along the blade span reveals that the rotor solidity is roughly 5.16%.

As indicated in Table 3-1, we incorporated eight unique airfoil-data tables for the NREL offshore 5-MW baseline wind turbine. The two innermost airfoil tables represent cylinders with drag coefficients of 0.50 (Cylinder1.dat) and 0.35 (Cylinder2.dat) and no lift. We created the remaining six airfoil tables by making corrections for three-dimensional behavior to the two-dimensional airfoil-data coefficients of the six airfoils used in the DOWEC study (as detailed in

Table 3-1. Distributed Blade Aerodynamic Properties

Node (-)	RNodes (m)	AeroTwst (°)	DRNodes (m)	Chord (m)	Airfoil Table (-)
1	2.8667	13.308	2.7333	3.542	Cylinder1.dat
2	5.6000	13.308	2.7333	3.854	Cylinder1.dat
3	8.3333	13.308	2.7333	4.167	Cylinder2.dat
4	11.7500	13.308	4.1000	4.557	DU40_A17.dat
5	15.8500	11.480	4.1000	4.652	DU35_A17.dat
6	19.9500	10.162	4.1000	4.458	DU35_A17.dat
7	24.0500	9.011	4.1000	4.249	DU30_A17.dat
8	28.1500	7.795	4.1000	4.007	DU25_A17.dat
9	32.2500	6.544	4.1000	3.748	DU25_A17.dat
10	36.3500	5.361	4.1000	3.502	DU21_A17.dat
11	40.4500	4.188	4.1000	3.256	DU21_A17.dat
12	44.5500	3.125	4.1000	3.010	NACA64_A17.dat
13	48.6500	2.319	4.1000	2.764	NACA64_A17.dat
14	52.7500	1.526	4.1000	2.518	NACA64_A17.dat
15	56.1667	0.863	2.7333	2.313	NACA64_A17.dat
16	58.9000	0.370	2.7333	2.086	NACA64_A17.dat
17	61.6333	0.106	2.7333	1.419	NACA64_A17.dat