STRUCTURAL DESIGN IS PERFORMED ACCORDING TO IEC 61400-1, EDITION 3, "WIND TURBINES - DESIGN REQUIREMENTS". EXTREME WIND CONDITIONS ARE DEFINED BY IEC WTGS CLASS IIIA.

TOWER TOP LOAD CALCULATION ACCORDING TO IEC 61400-1 IS SIMILAR TO THAT DESCRIBED BY SECTION 6.5 (ANALYTICAL PROCEDURE) OF ASCE 7-05. STRUCTURAL DESIGN INFORMATION USED BY NORTHERN POWER IS ACCORDING TO IEC 61400-1 AND IS PRESENTED BELOW IN A FORM CONSISTENT WITH ASCE 7-05.

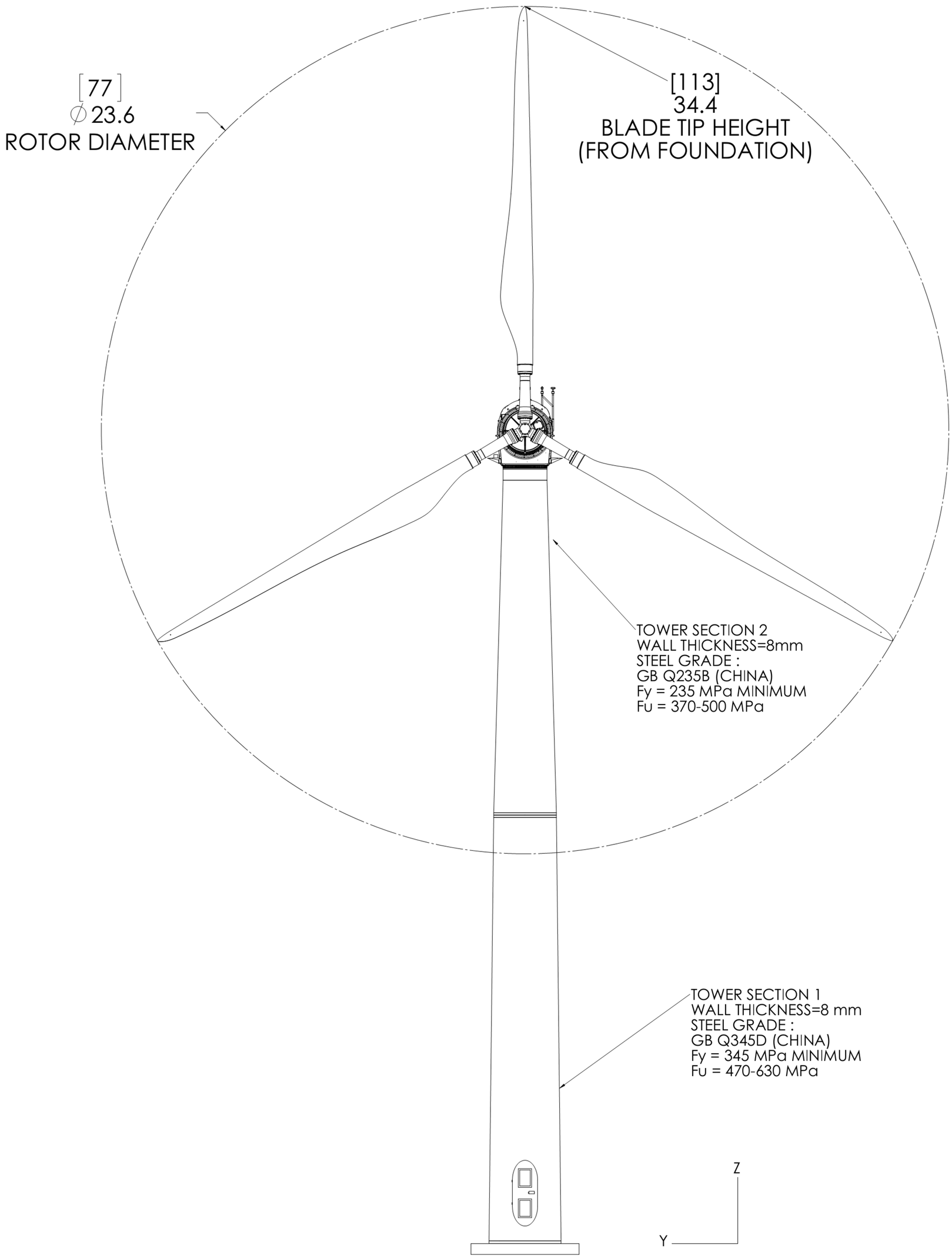
CHARACTERISTIC (UNFACTORED) LOADS AT TOWER TOP .....SEE NOTE 1
- Fxy (Shear): 58.3 kN (13.1 kip)
- Fz (Weight): -78.5 kN (-17.6 kip)
- Mxy (Overturning Moment): 45.8 kN-m (33.8 kip-ft)
- Mz (Torsional Moment): 14.1 kN-m (10.4 kip-ft)

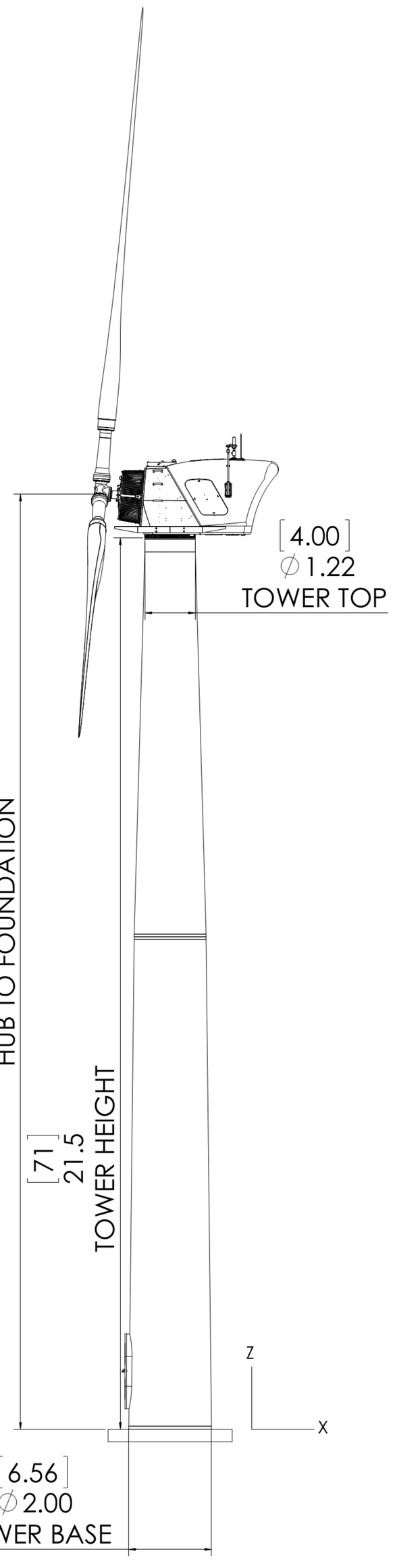
CHARACTERISTIC (UNFACTORED) LOADS AT TOWER BASE .....SEE NOTE 2
- Fxy (Shear): 94.1 kN (21.2 kip)
- Fz (Weight): -149.2 kN (-33.5 kip)
- Mxy (Overturning Moment): 1697.5 kN-m (1251.9 kip-ft)
- Mz (Torsional Moment): 14.1 kN-m (10.4 kip-ft)
- Mz Maximum (Torsional Moment): 46.9 kN-m (34.6 kip-ft)

BASIC WIND SPEED, V = 48.0 m/s (107 mph).....SEE NOTE 3
AIR DENSITY, ρ = 1.225 kg/m^3 (0.0765 lbm/ft^3).....SEE NOTE 4
IMPORTANCE FACTOR, I = 1.0
EXPOSURE CATEGORY = C
WIND DIRECTIONALITY FACTOR, Kd = 1.0.....SEE NOTE 5
TOWER HEIGHT, h = 21.5 m (71 ft)
TOPOGRAPHIC FACTOR, Kzt = 1.0.....SEE NOTE 6
GUST EFFECT FACTOR, G = 1.0.....SEE NOTE 7
TOWER FORCE COEFFICIENT, Cf = 0.6

FOUNDATION STIFFNESS REQUIREMENTS .....SEE NOTE 10
- LATERAL FOUNDATION STIFFNESS, Kxy = 1 X 10^8 N/m MINIMUM
- ROTATIONAL FOUNDATION STIFFNESS, KΘ,xy = 1.25 X 10^9 N-m/rad MINIMUM

NOTES
1. TOWER TOP LOADS PROVIDED INCLUDE EFFECTS OF THE WIND ON THE BLADES AND NACELLE. NORTHERN POWER USED A LOAD FACTOR OF 1.35 (NOT INCLUDED ABOVE) FOR ALL AERODYNAMIC LOADS ON THE STRUCTURE ACCORDING TO IEC 61400-1.
2. TOWER BASE LOADS PROVIDED INCLUDE EFFECTS OF THE WIND ON THE BLADES, NACELLE, AND TOWER. NORTHERN POWER USED A LOAD FACTOR OF 1.35 (NOT INCLUDED ABOVE) FOR ALL AERODYNAMIC LOADS ON THE STRUCTURE ACCORDING TO IEC 61400-1. "Mz" AND "Mz MAXIMUM" ARE DERIVED FROM DIFFERENT LOAD CASES. NOTE THAT "Mz MAXIMUM" DOES NOT OCCUR DURING THE 50-YEAR EXTREME GUST LOAD CASE, BUT MAY BE CONSERVATIVELY ASSUMED IN LOAD COMBINATION FOR PURPOSES OF FOUNDATION DESIGN.
3. BASIC WIND SPEED IS AT h=10m (33 ft). THIS VALUE IS DERIVED FROM THE EXTREME WIND SPEED AT HUB HEIGHT ACCORDING TO IEC 61400-1, Ve50 = 52.5 m/s (117 mph), USING A POWER LAW EXPONENT CONSISTENT WITH EXPOSURE C.
4. STANDARD AIR DENSITY IS NOT EXPLICITLY IDENTIFIED IN SECTION 6.5 OF ASCE 7-05. IT IS IMPLICIT IN THE VELOCITY PRESSURE CALCULATION, EQUATION 6-15.
5. A DIRECTIONALITY FACTOR IS NOT USED BY NORTHERN POWER.
6. EFFECTS OF LOCAL TOPOGRAPHY ON THE WIND ARE NOT ACCOUNTED FOR IN THIS CALCULATION. THEY MUST BE CONSIDERED DURING PROJECT PLANNING AND SITE REVIEW.
7. THE TOWER LOADS ARE PREDICTED USING A COMPLETE AERO-ELASTIC SIMULATION WHICH ACCOUNTS FOR DYNAMIC INTERACTIONS OF THE STRUCTURE AND THE APPLIED LOADS. AN ADDITIONAL GUST EFFECT FACTOR (E.G. ACCORDING TO SECTION 6.5.8 OF ASCE 7-05) IS THEREFORE NOT USED BY NORTHERN POWER.
8. SEISMIC ACTIONS ARE NOT ACCOUNTED FOR IN THIS CALCULATION. THOUGH TYPICALLY NON-GOVERNING, THEY MUST BE CONSIDERED DURING PROJECT PLANNING AND SITE REVIEW.
9. THE VALUES STATED IN METRIC (SI) UNITS SHALL BE REGARDED AS THE STANDARD. THE INCH-POUND (IP) UNITS SHOWN IN PARENTHESES SHALL BE FOR REFERENCE ONLY.
10. NORTHERN POWER IS CONTINUALLY DEVELOPING PRODUCT UPGRADES, MODIFICATIONS, AND IMPROVEMENTS, AND AS A RESULT RESERVES THE RIGHT TO CHANGE OR ALTER THESE SPECIFICATIONS AT ANY TIME. REFER TO DOCUMENT A05450 "NPS100-24 GENERAL SPECIFICATION" AND DOCUMENT A00298 "NPS100 APPLICATION REQUIREMENTS" FOR FURTHER INFORMATION.




# NPS100-24-23

STRUCTURAL LOADS AND GEOMETRY
ROTOR DIAMETER: 24m
HUB HEIGHT: 23m
SCALE 1:50
WHEN PRINTED ON ISO A0
ALL DIMENSIONS IN METERS AND [FEET]



| REV | DESCRIPTION | DATE | ENG | CHK | APR |
|---|---|---|---|---|---|
| | | | | | |
| C | RELEASE FOR CUSTOMER USE, ADDED NPS100-24-30, UPDATED LOADS NOTES AND FORMATTING | 7/25/2012 | NMS | CBC | DPC |
| B | RELEASE FOR BID/QUOTE | 4/9/2012 | NMS | CBC | DPC |
| A | RELEASE FOR BID/QUOTE | 12MAR12 | CBC | NMS | CAM |

| DRAWING NUMBER: 1013417 | REVISION: C | SHEET: 3 OF 3 |
|---|---|---|

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