

Appendix: injury criteria for all pedestrians

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1 Introduction

1.1 Simplified box plot

Figure 1 illustrates the use of the simplified box plot (also called box-and-whisker plot) for the synthetic representation of scatter points. The simplified box plot was introduced by Tufte [1] and allows a more "concise" representation of data (higher data/ink ratio).

The box plot shows:

- the extrema -minimum and maximum- (ends of the whiskers);
- the median (blue point);
- the quartiles (the whiskers depict the first quartile Q1 et the fourth quartile Q4, the intervals between the whiskers and the median depict quartiles Q2 and Q3);
- the mean (red cross);
- the number of points underlying the box is written at the top right of the box (grey figure).

1.2 List of pedestrians

The present appendix shows the injury criteria for the following pedestrians and tramway speeds:

- M50 pedestrian model, 20 km h⁻¹;
- M50 pedestrian model, 30 km h⁻¹;
- C06 pedestrian model, 20 km h⁻¹;
- F05 pedestrian model, 20 km h⁻¹;
- M95 pedestrian model, 20 km h⁻¹.

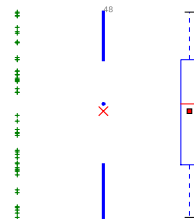


Figure 1: Scatter points, simplified box plot, classical box plot

1.3 List of injury criteria

Here is the list of the injury criteria and their description:

- Head:
 - **hic**: Head Injury Criterion
 - **cumHead**: cumulative 3 ms $[\text{m s}^{-2}]$ head acceleration
- Thorax:
 - **v*c**: viscous criterion $[\text{m s}^{-1}]$
 - **comp**: thorax compression [%]
- Femur:
 - **LegUp3L_ForceLat**: lateral force on left femur [N]
 - **LegUp3L_TorqueLat**: lateral torque on left femur [N m]
- Knee:
 - **KneeL_theta**: lateral knee bending angle [rad]
 - **KneeShearL_Y**: lateral knee shear displacement [m]
- Tibia:
 - **LegLow3L_lacY**: lateral tibia acceleration $[\text{m s}^{-1}]$

The injury threshold (see Appendix 2) is indicated on each plot with a red horizontal line. The green line on each plot is the linear regression line.

2 Head injury

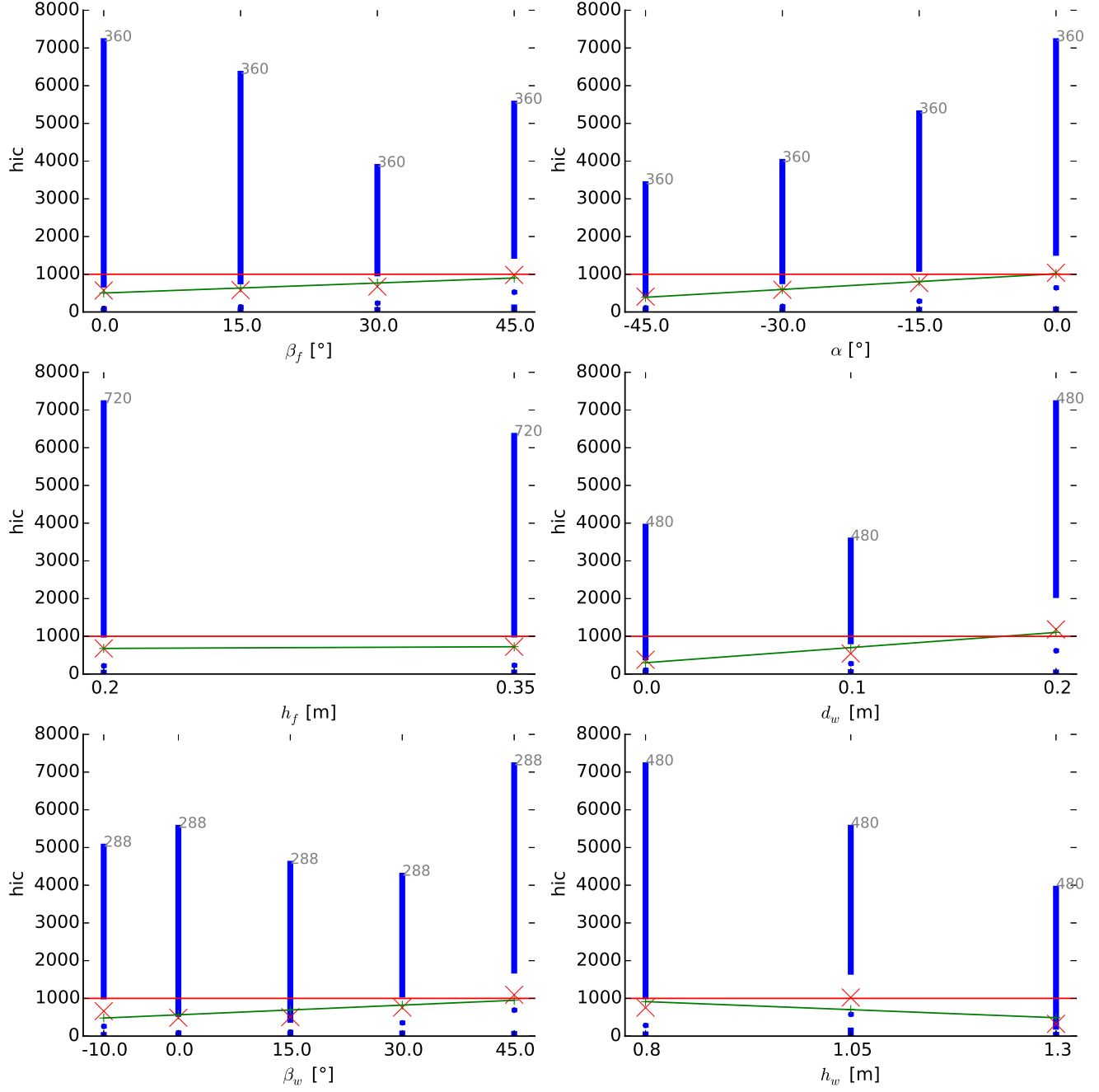


Figure 2: hic, M50 pedestrian, 20 km h⁻¹

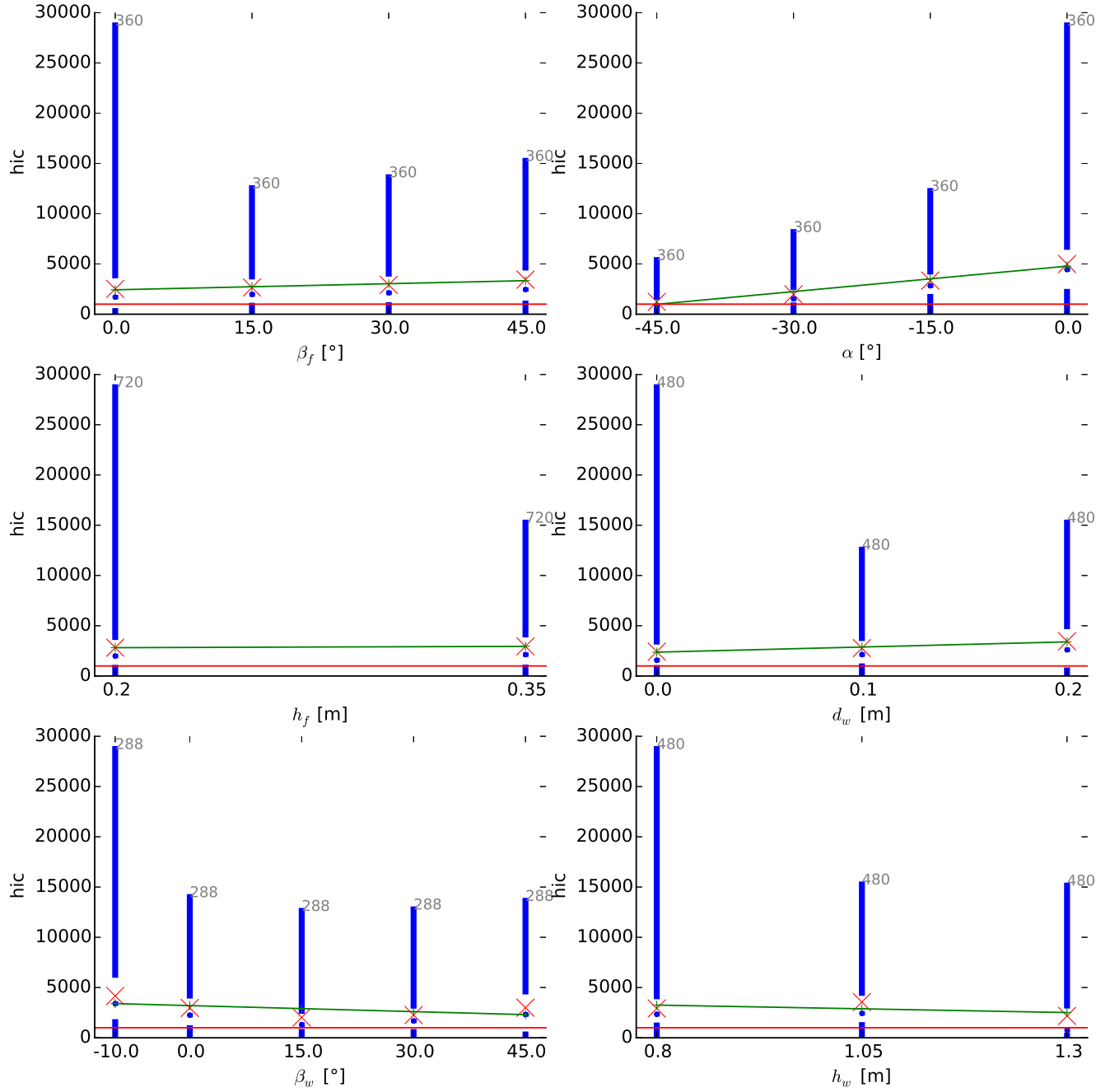


Figure 3: hic, M50 pedestrian, 30 km h⁻¹

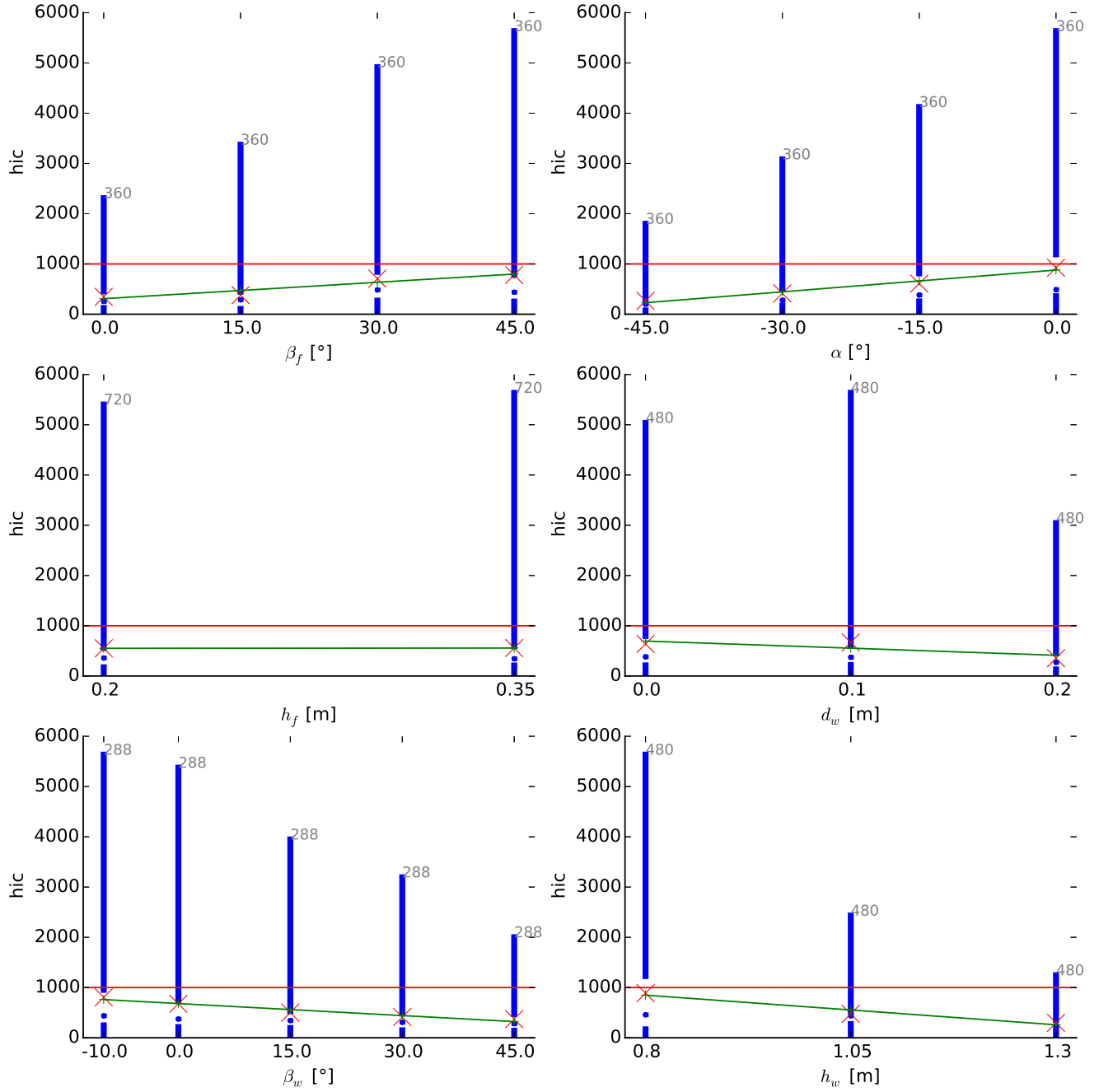


Figure 4: hic, C06 pedestrian, 20 km h⁻¹

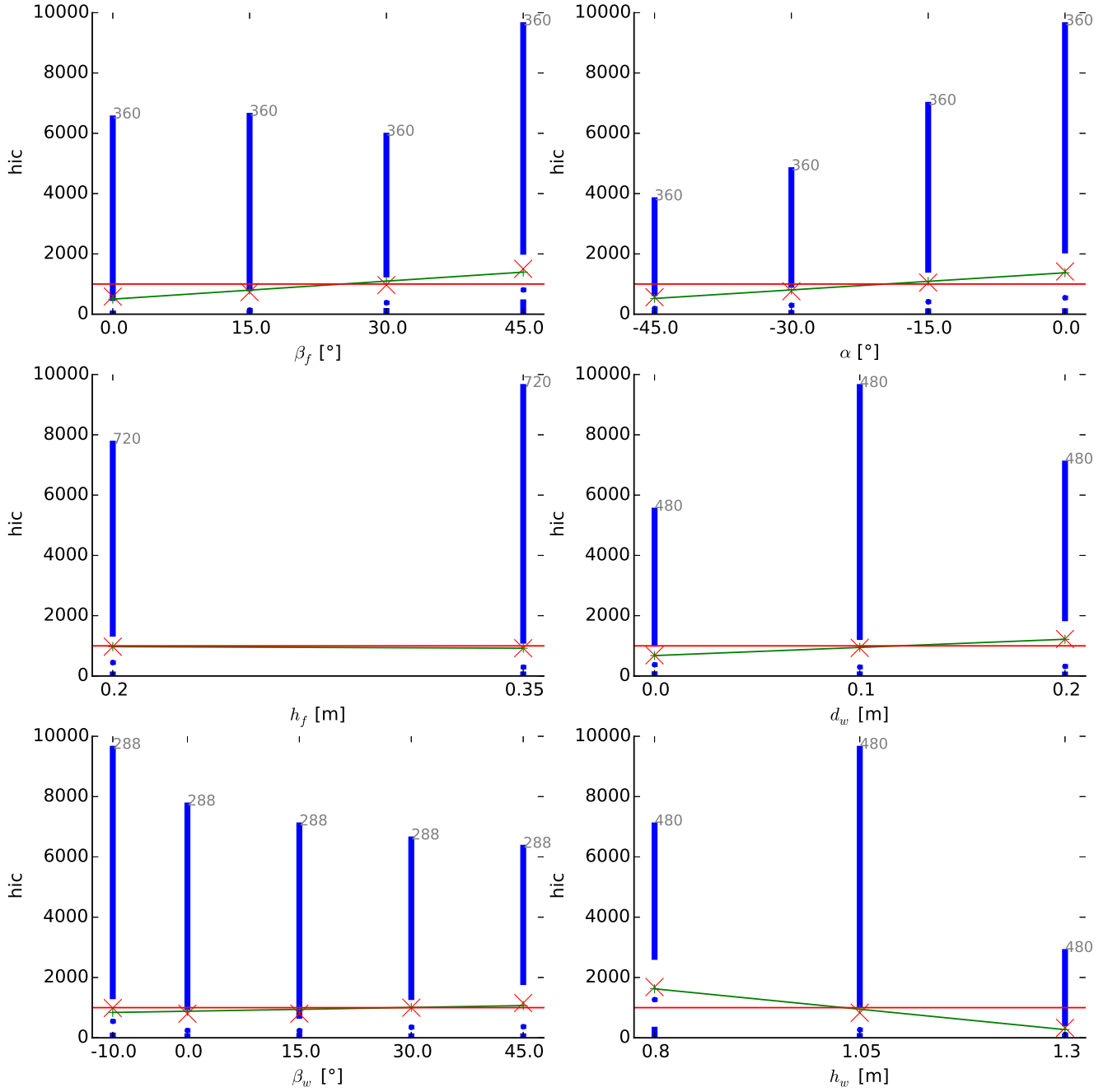


Figure 5: hic, F05 pedestrian, 20 km h⁻¹

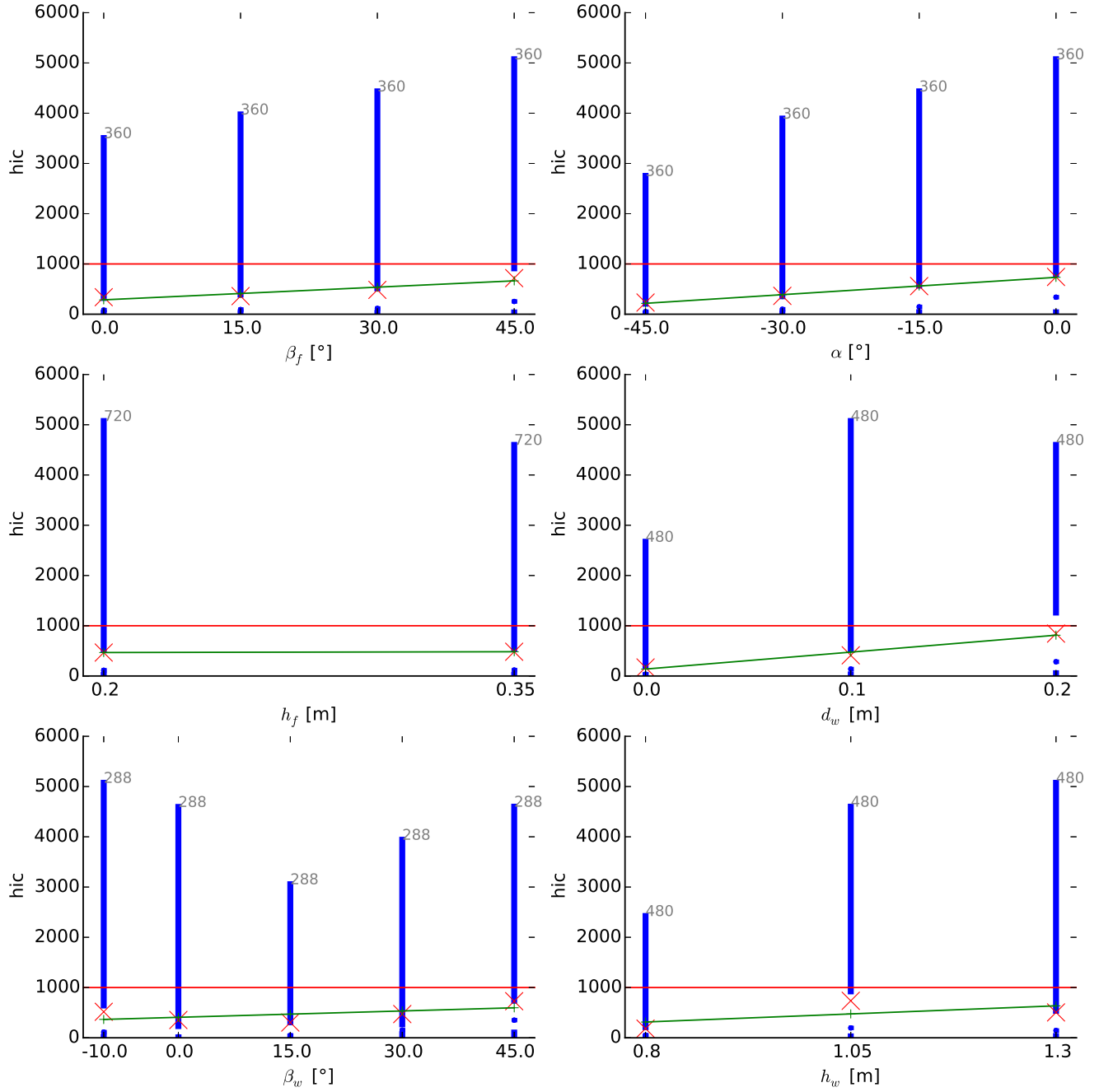


Figure 6: hic, M95 pedestrian, 20 km h⁻¹

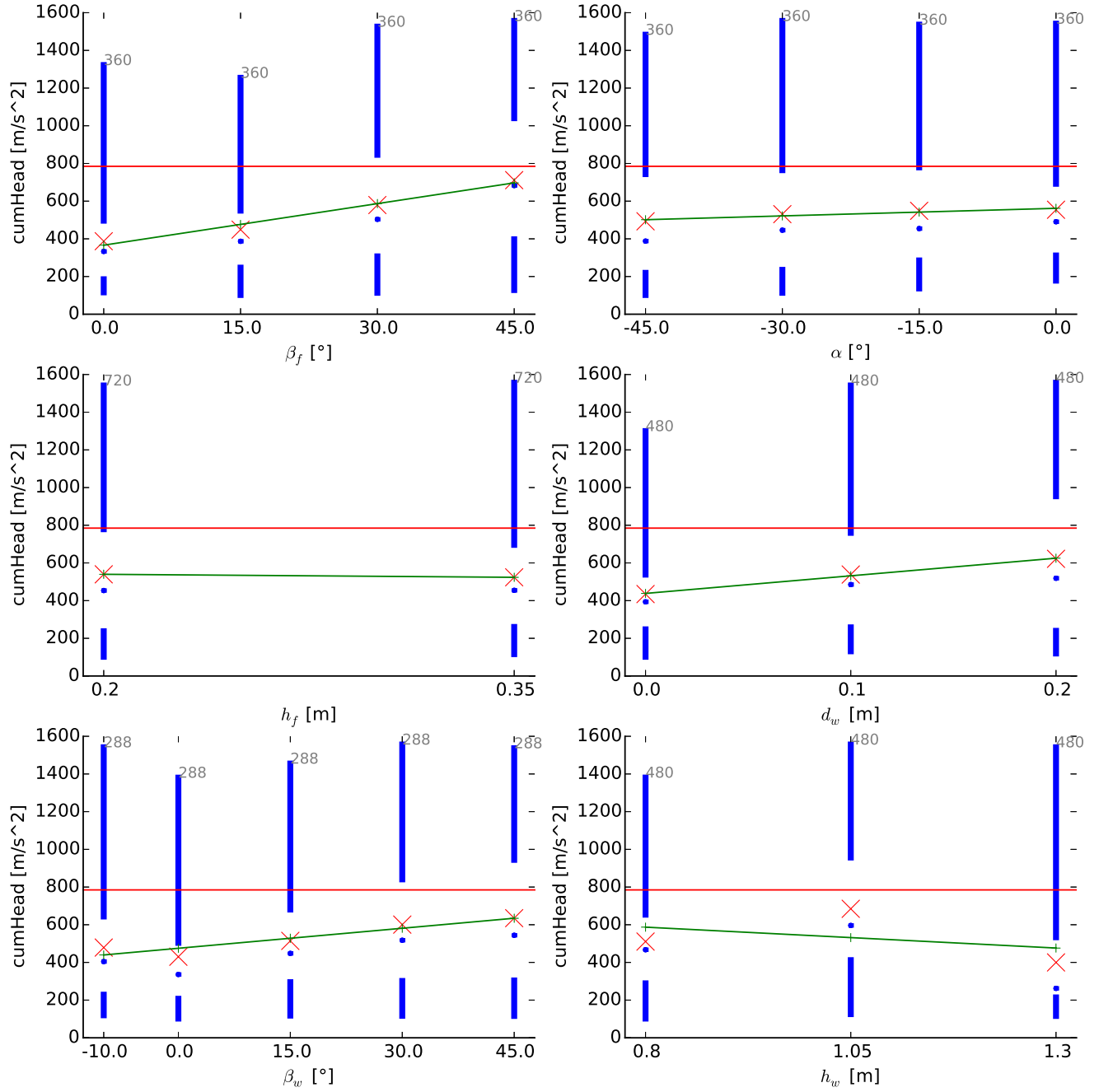


Figure 7: cumHead, M50 pedestrian, 20 km h^{-1}

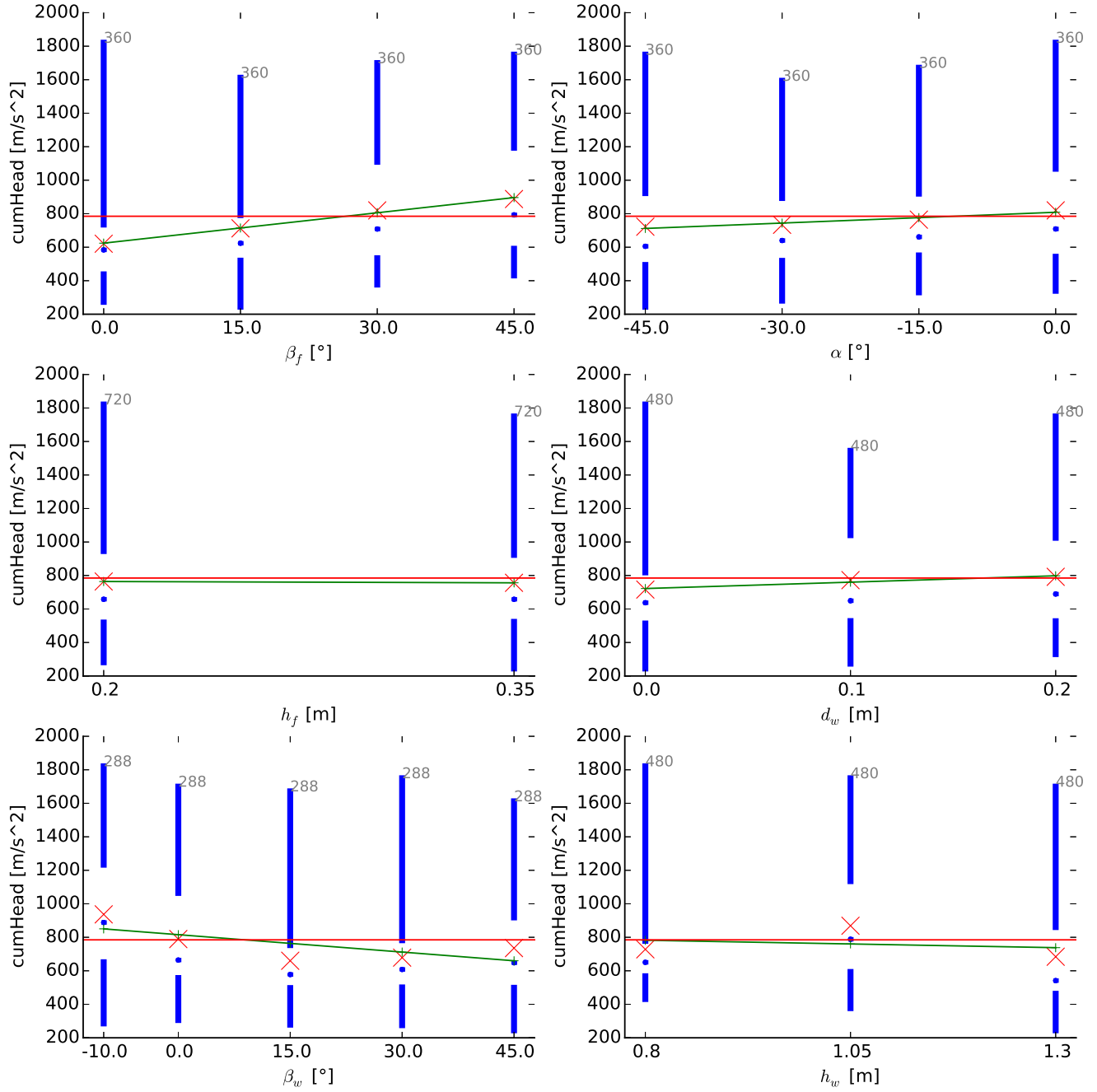


Figure 8: cumHead, M50 pedestrian, 30 km h^{-1}

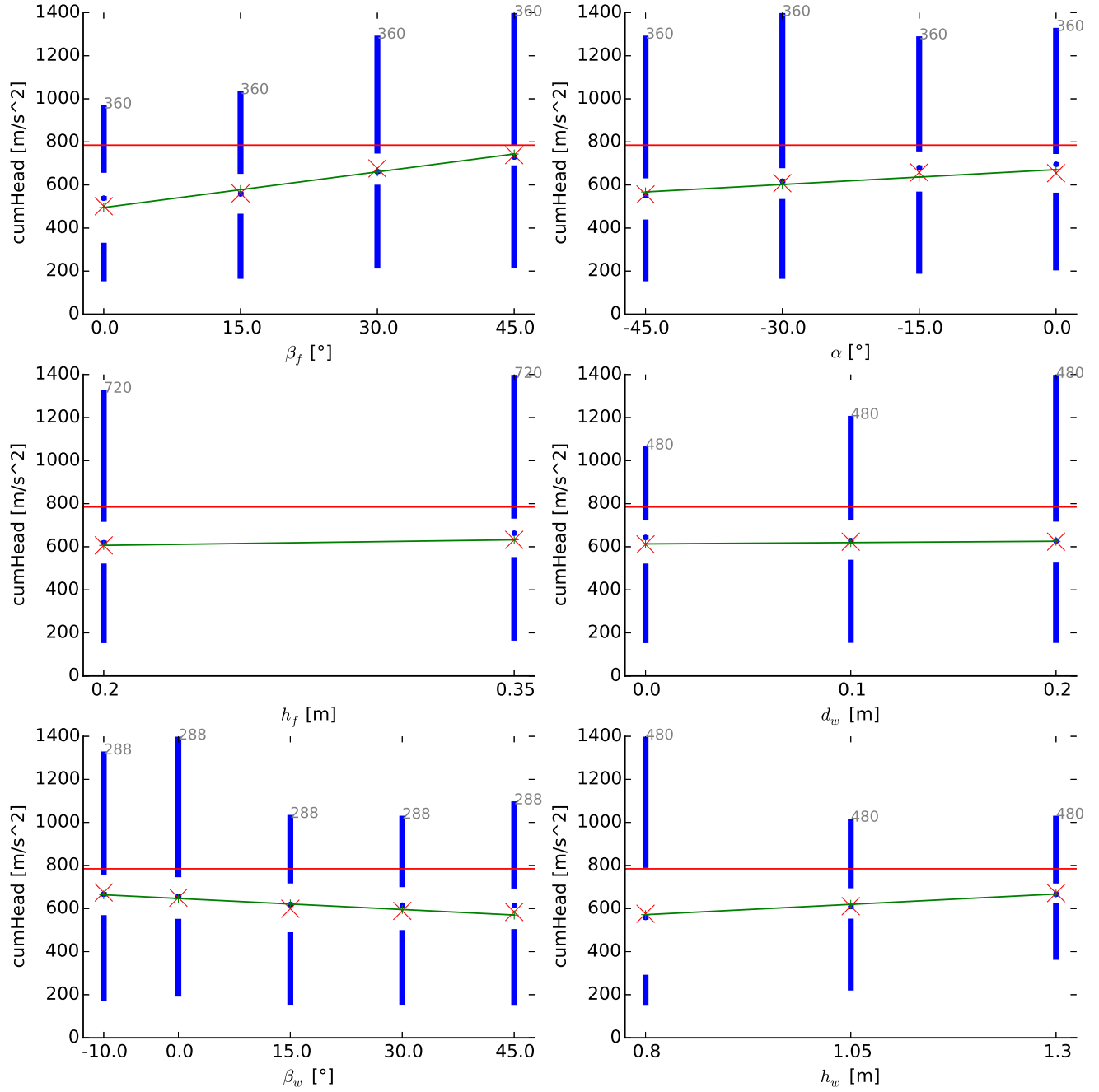


Figure 9: cumHead, C06 pedestrian, 20 km h^{-1}

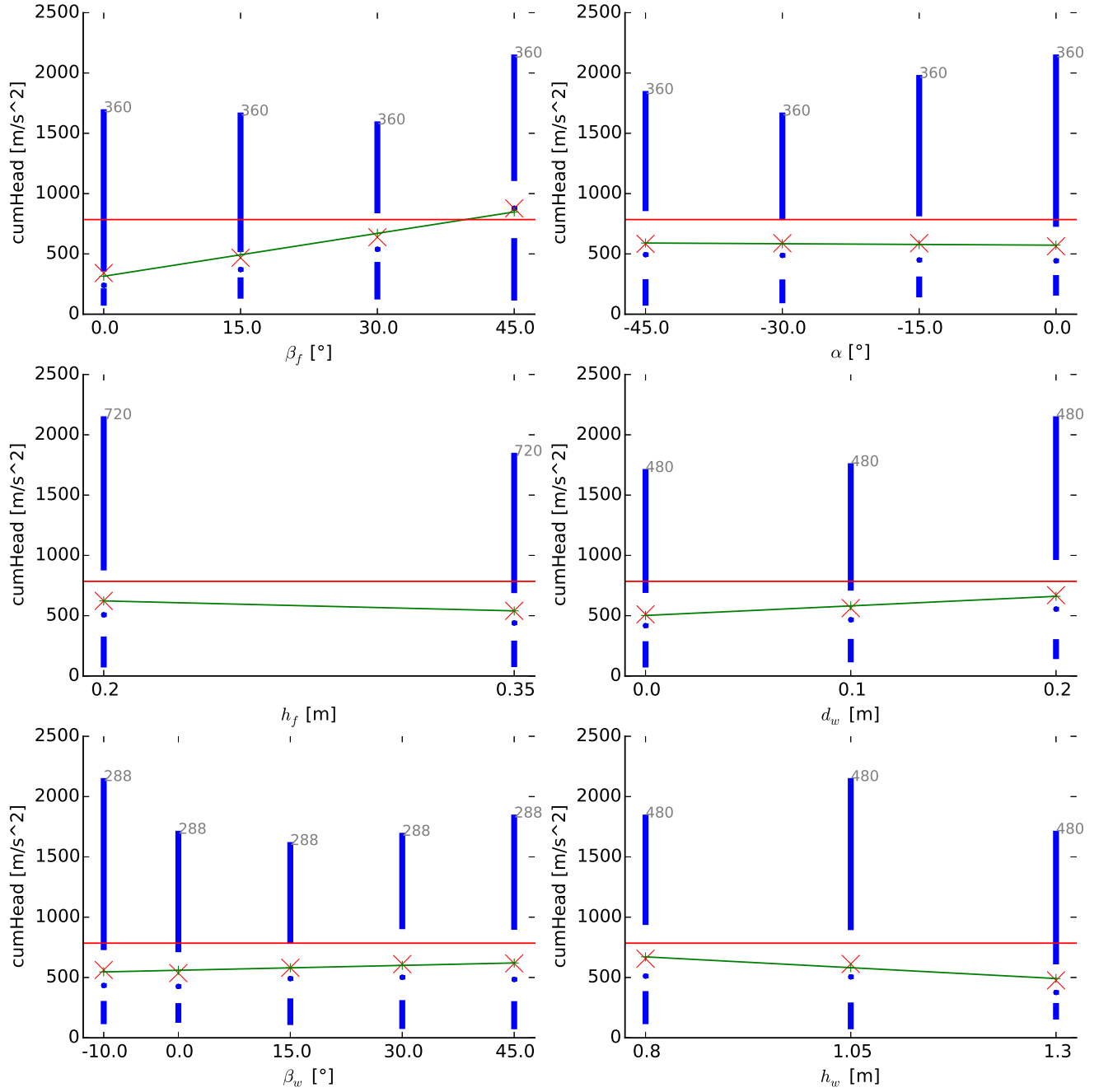


Figure 10: cumHead, F05 pedestrian, 20 km h^{-1}

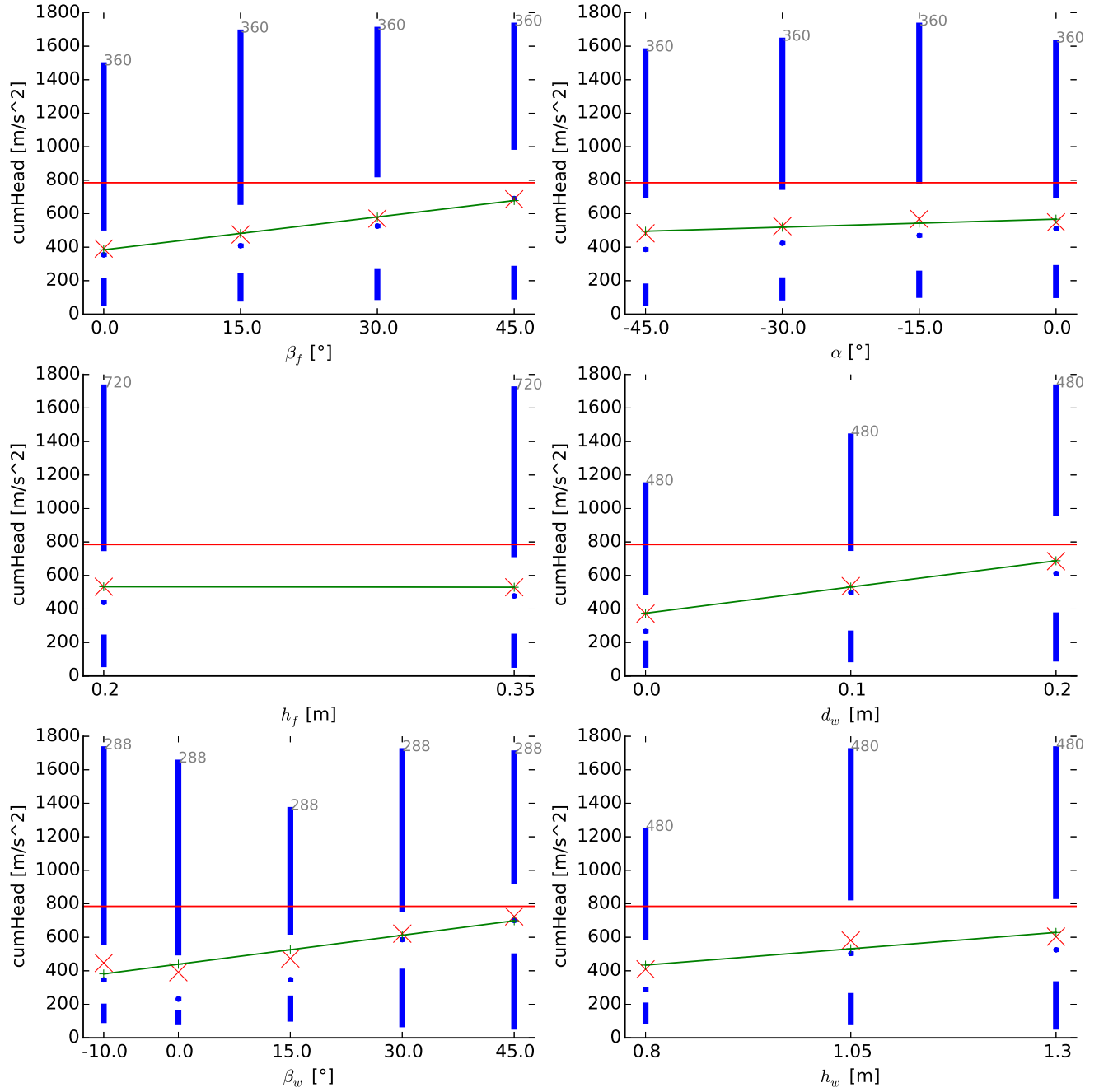


Figure 11: cumHead, M95 pedestrian, 20 km h^{-1}

3 Thorax injury

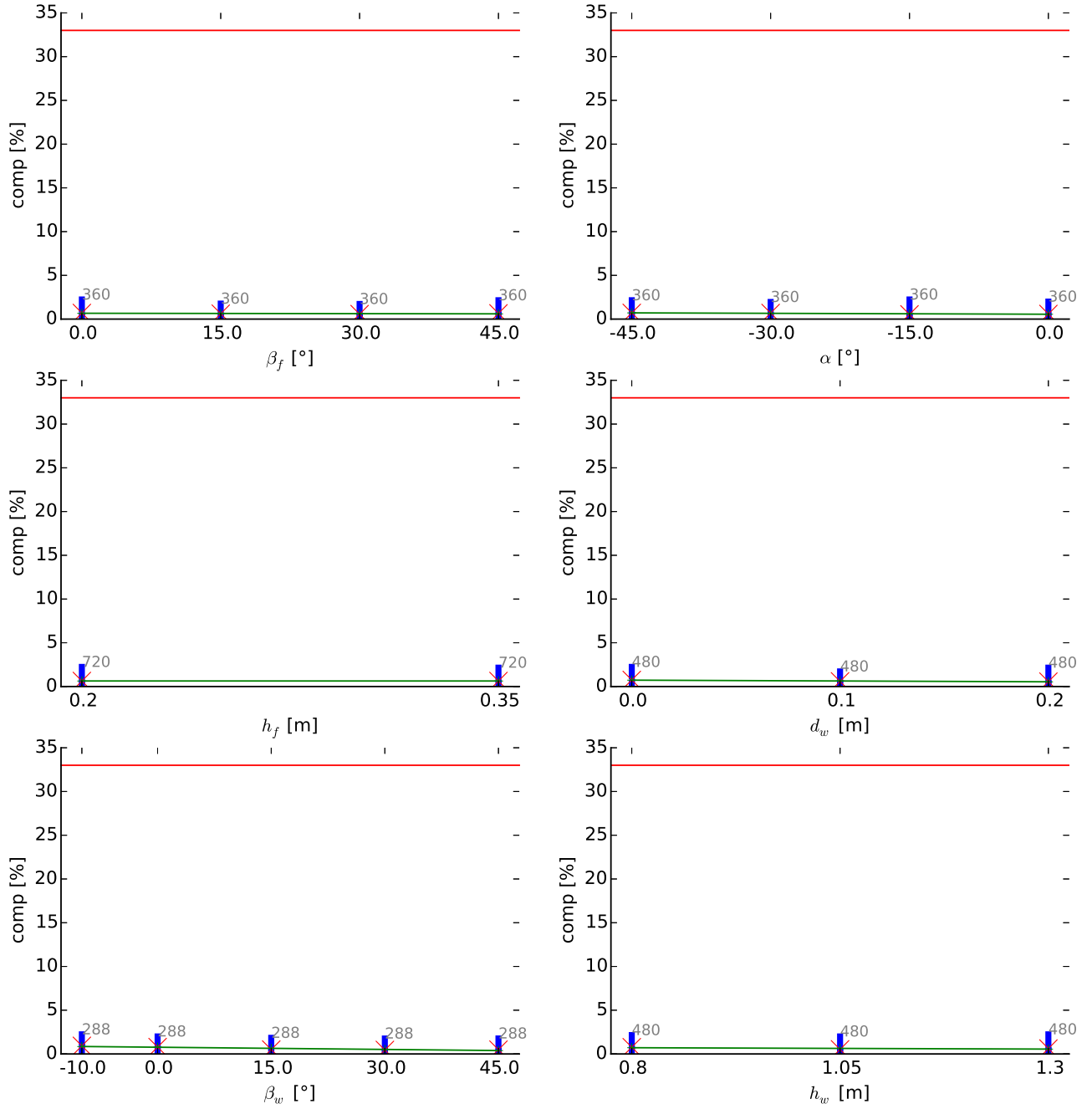


Figure 12: comp, M50 pedestrian, 20 km h⁻¹

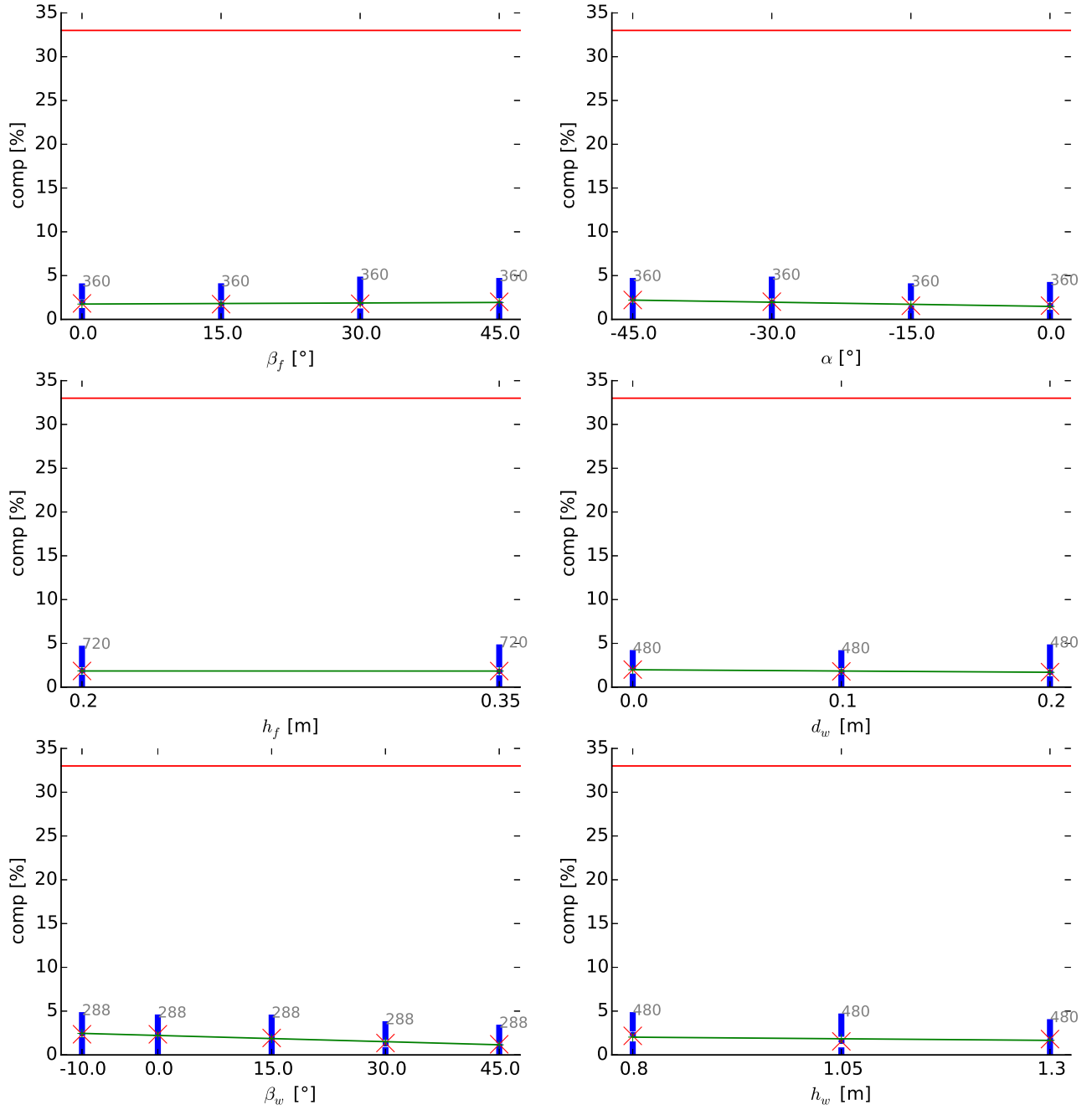


Figure 13: comp, M50 pedestrian, 30 km h⁻¹

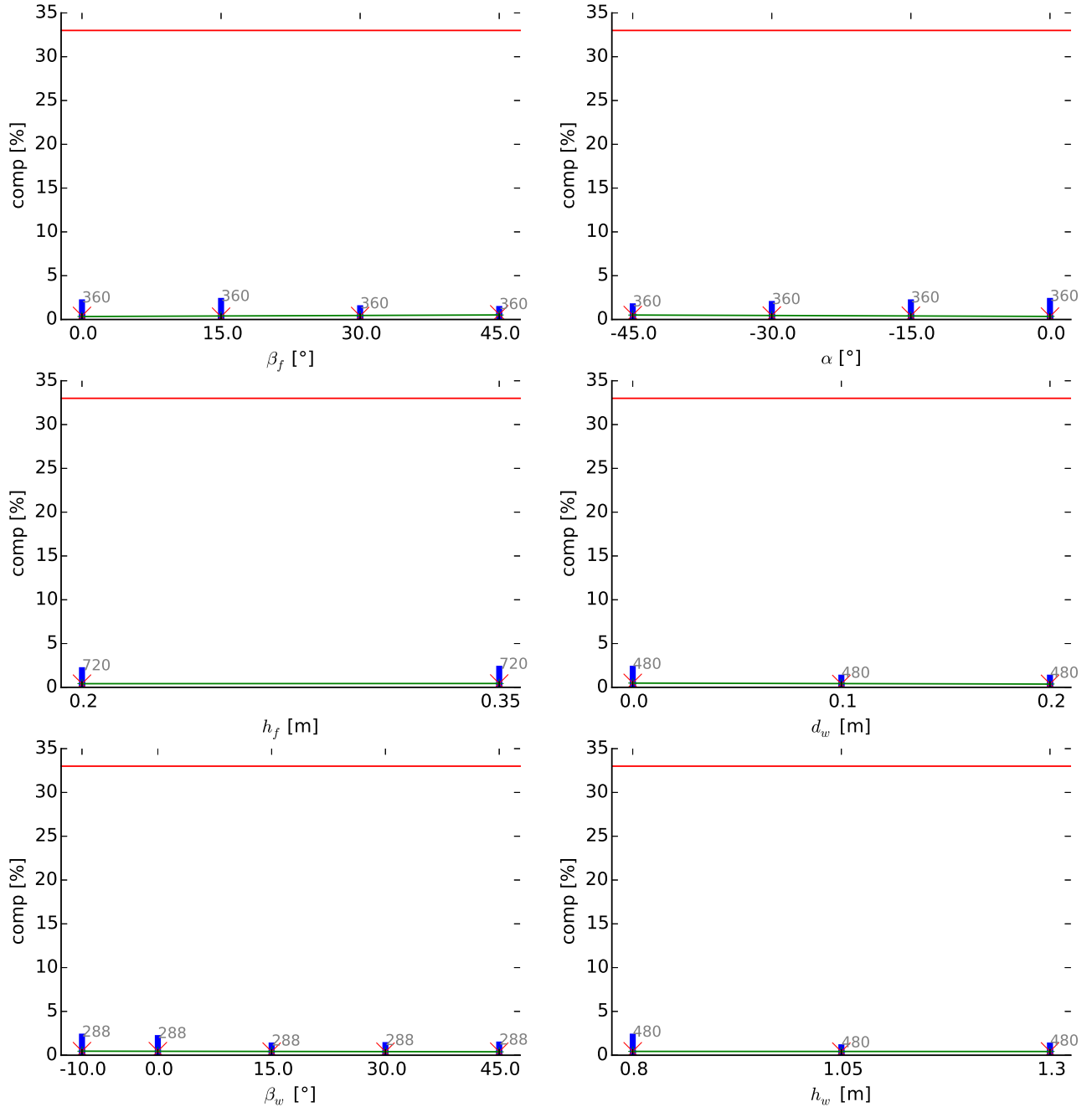


Figure 14: comp, C06 pedestrian, 20 km h⁻¹

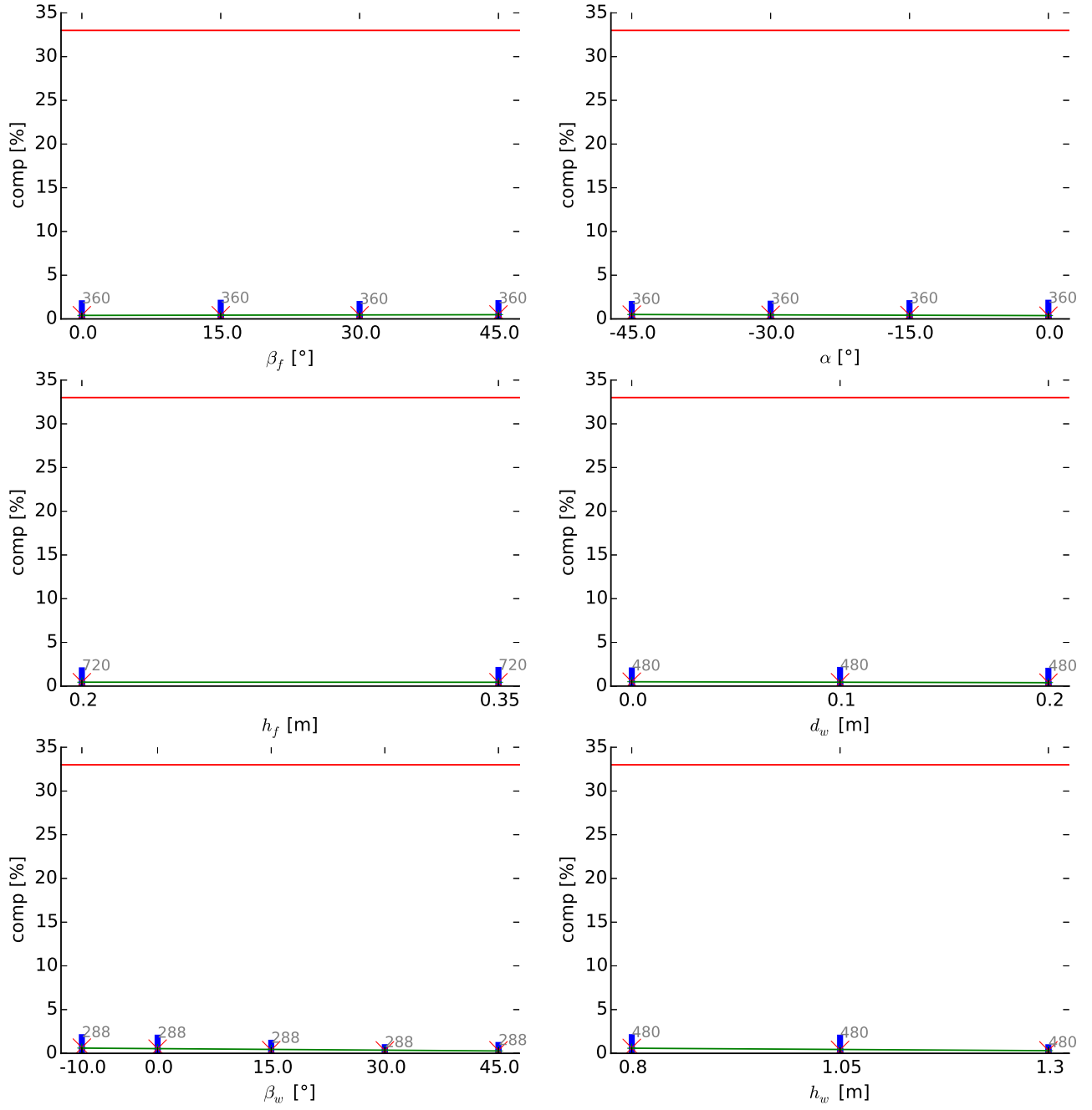


Figure 15: comp, F05 pedestrian, 20 km h⁻¹

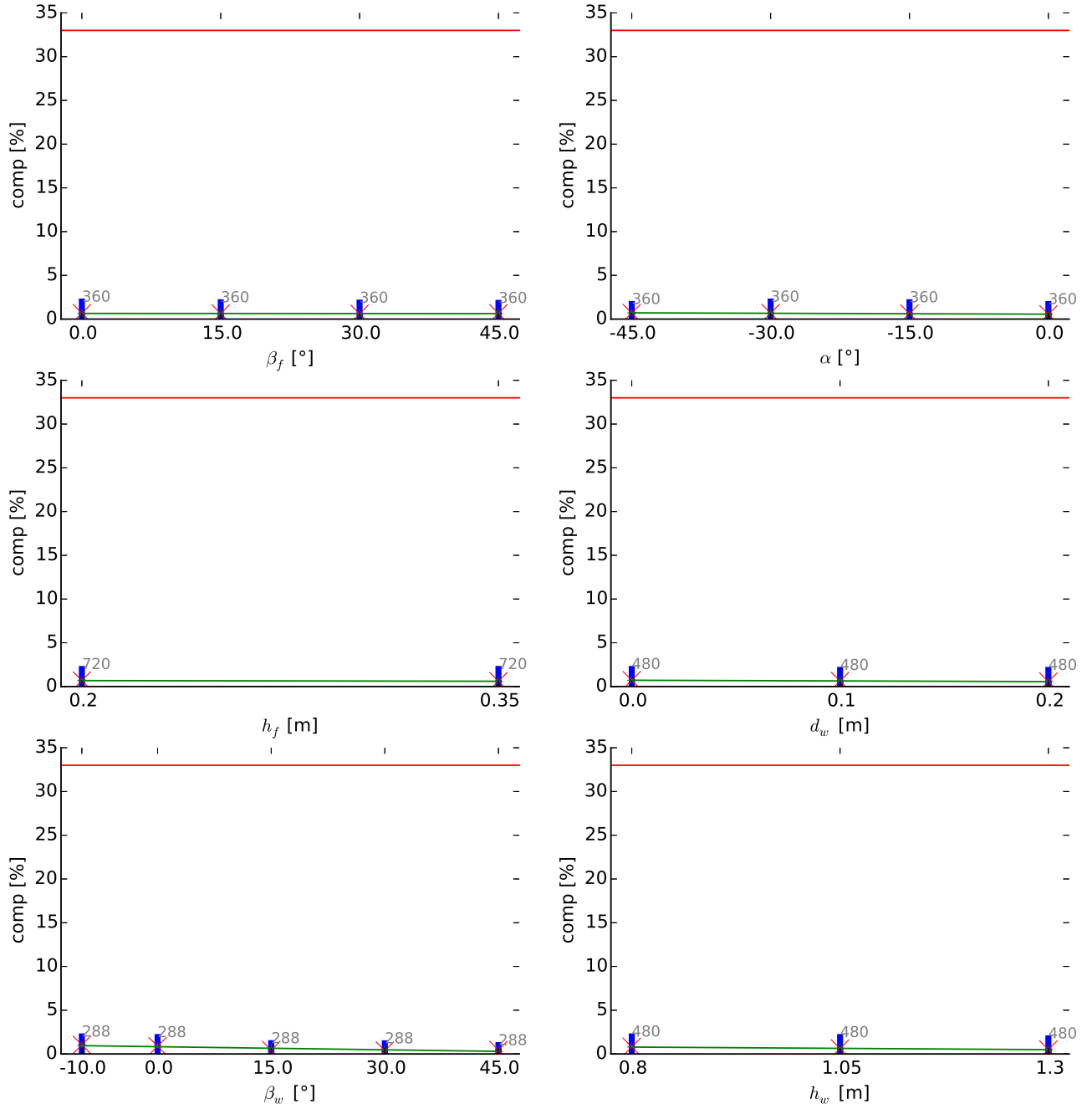


Figure 16: comp, M95 pedestrian, 20 km h⁻¹

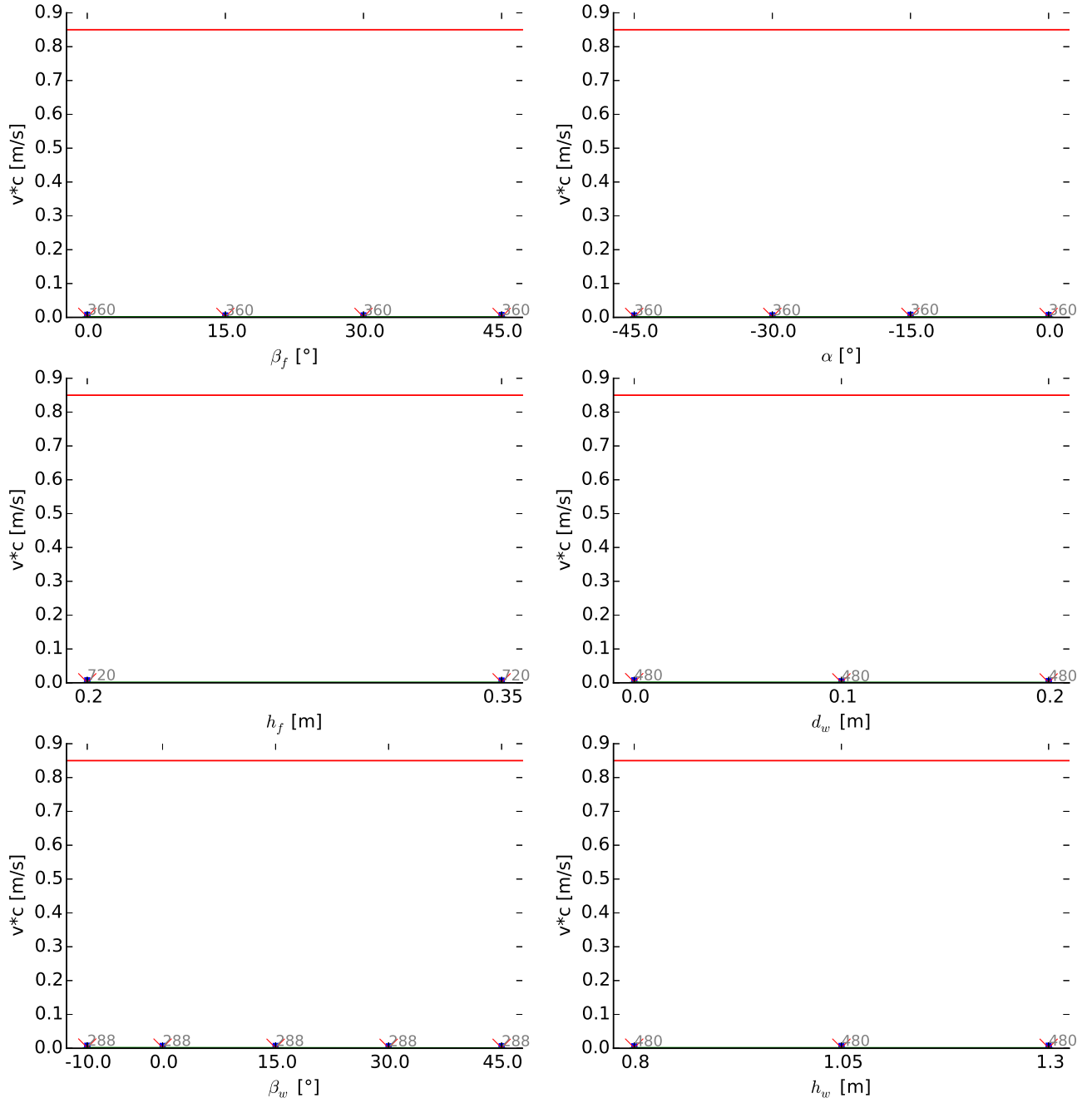


Figure 17: v^*c , M50 pedestrian, 20 km h^{-1}

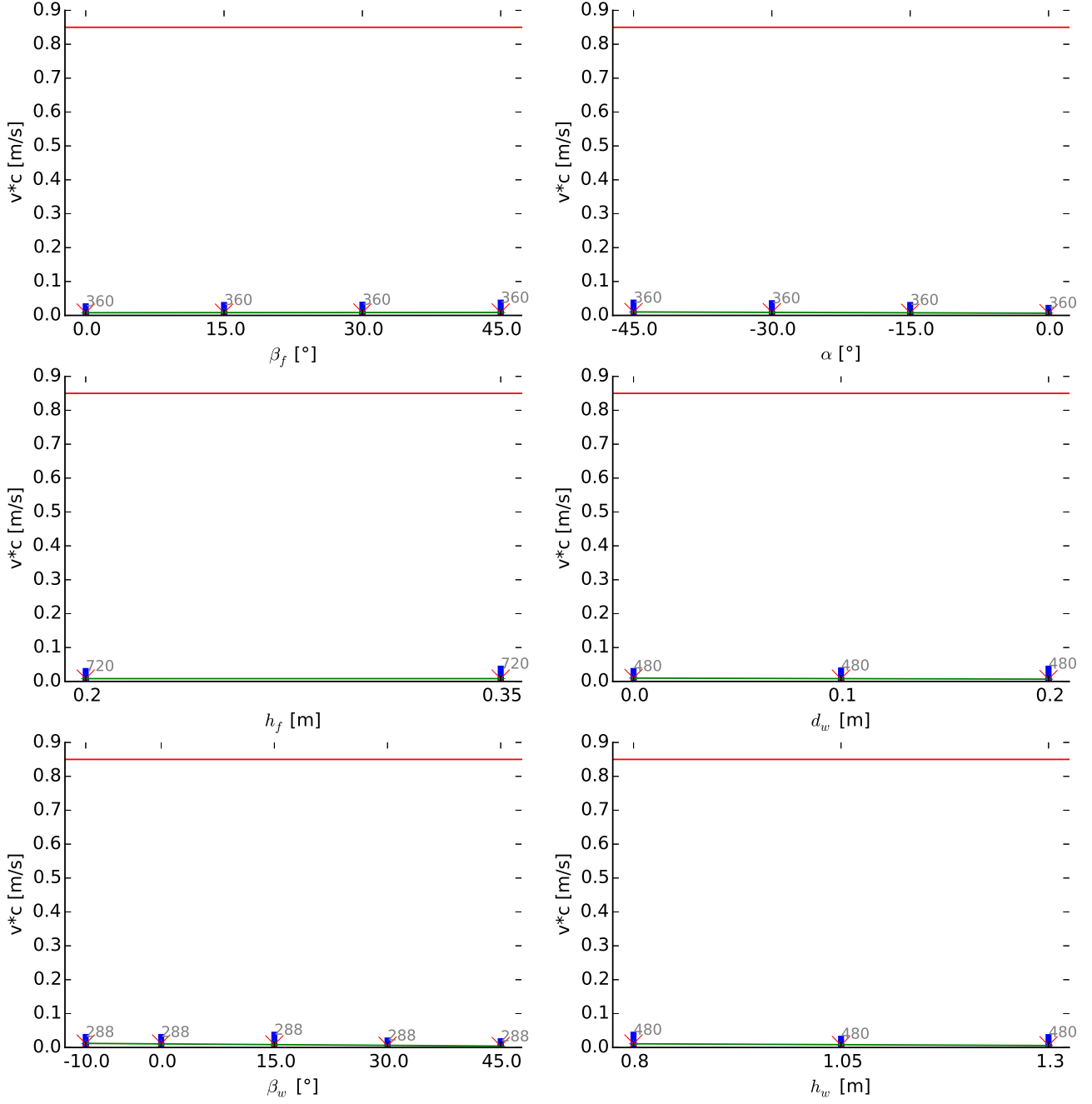


Figure 18: v^*c , M50 pedestrian, 30 km h^{-1}

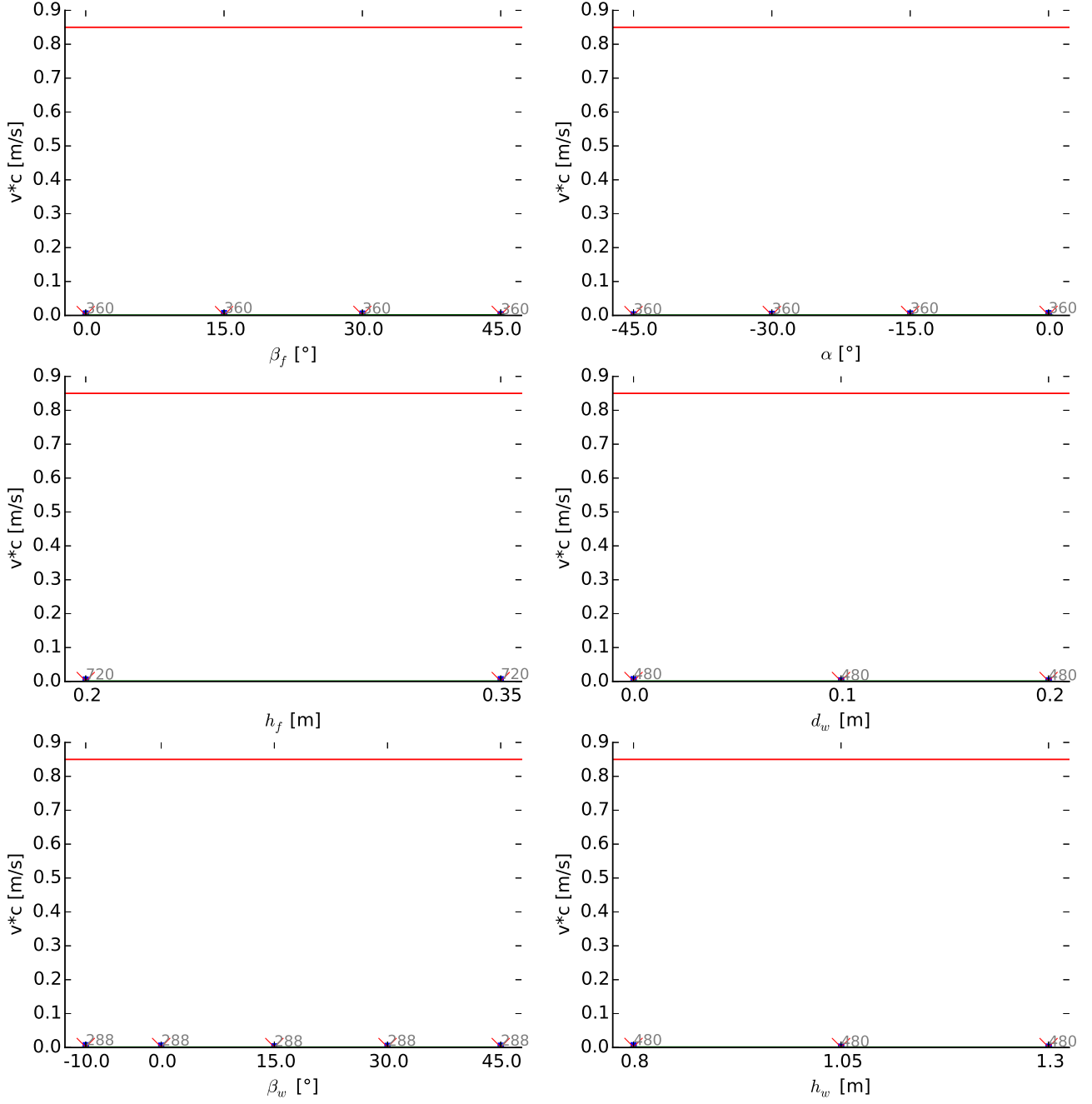


Figure 19: v^*c , C06 pedestrian, 20 km h^{-1}

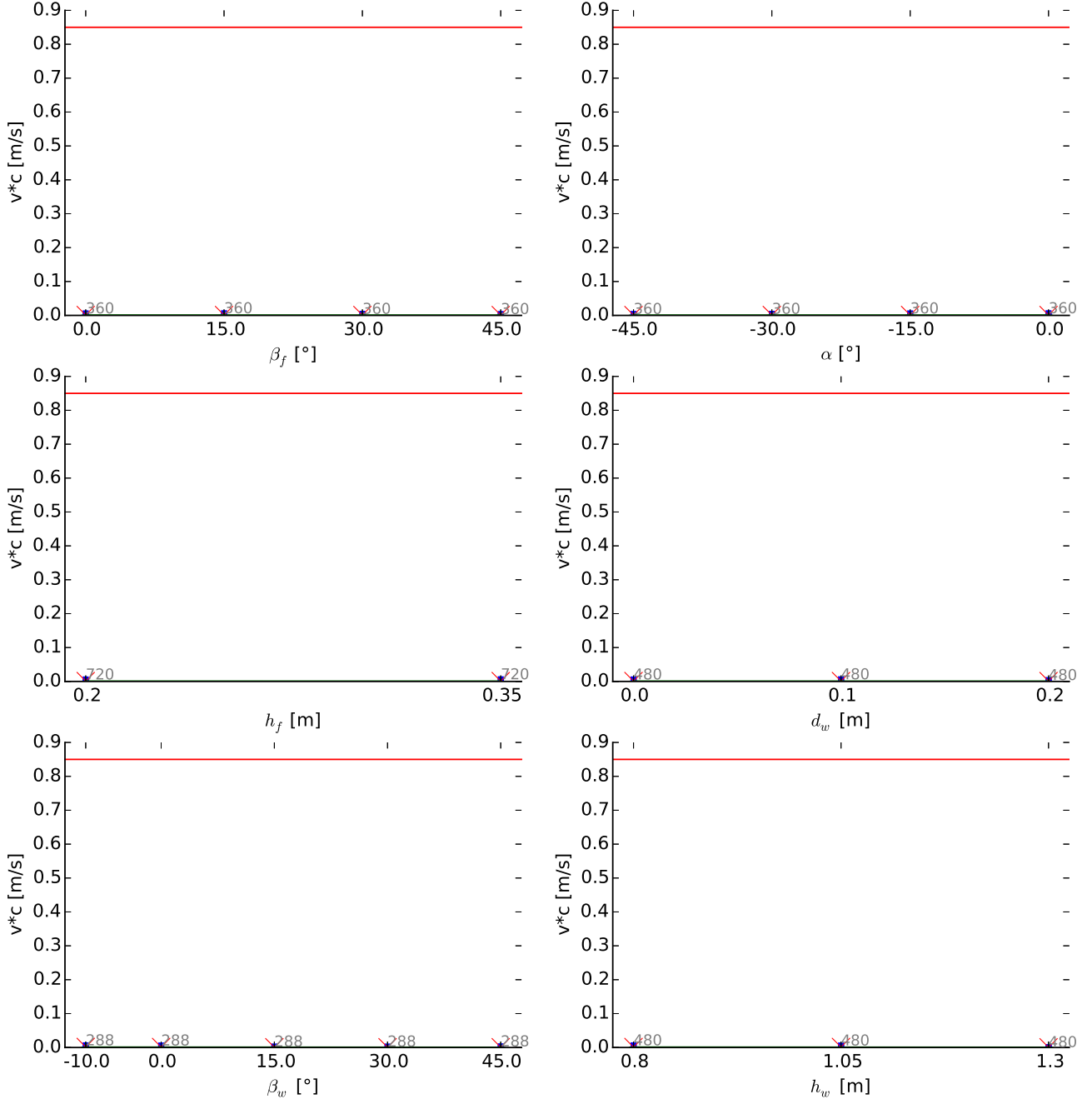


Figure 20: v^*c , F05 pedestrian, 20 km h^{-1}

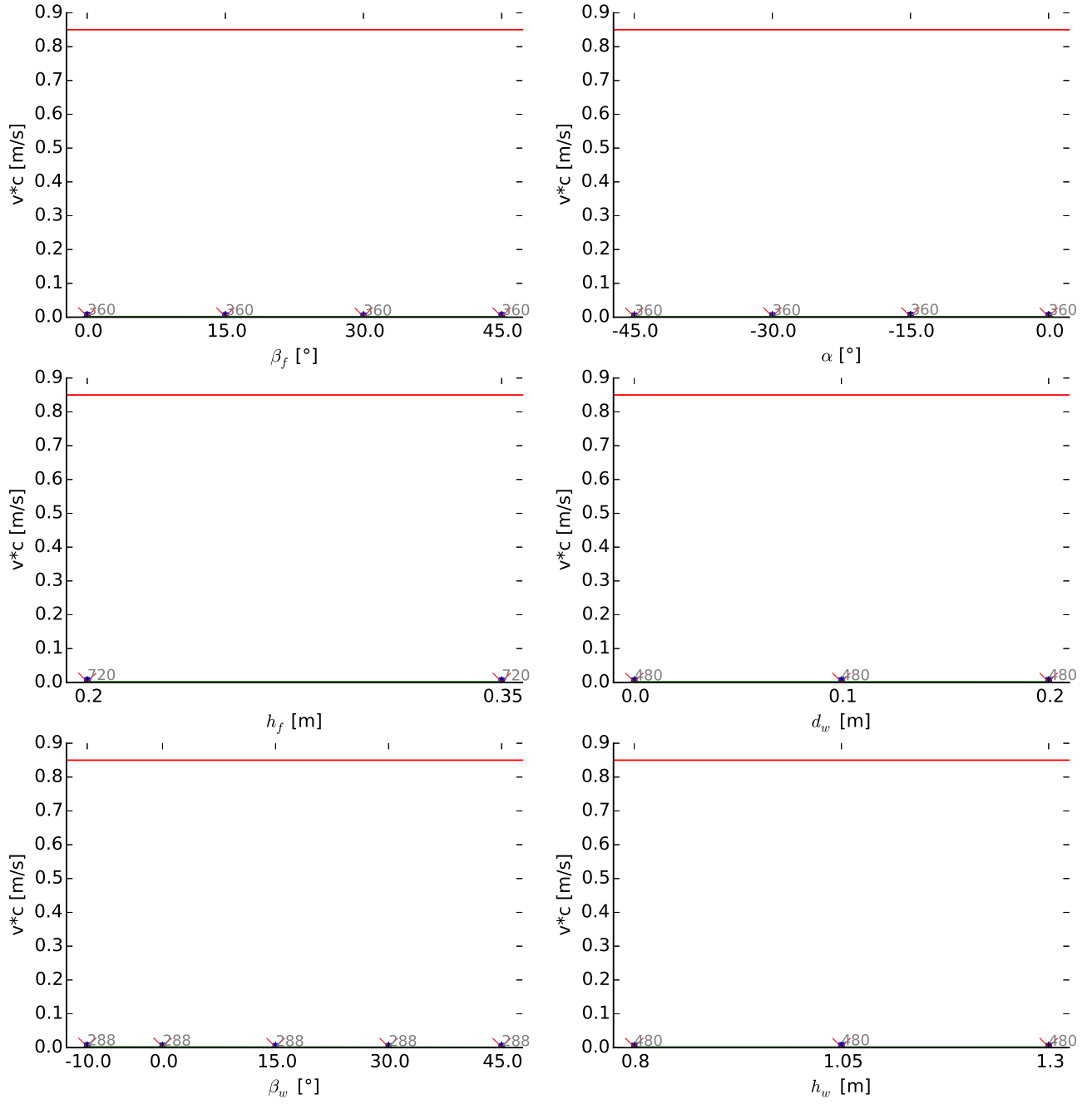


Figure 21: v^*c , M95 pedestrian, 20 km h^{-1}

4 Femur injury

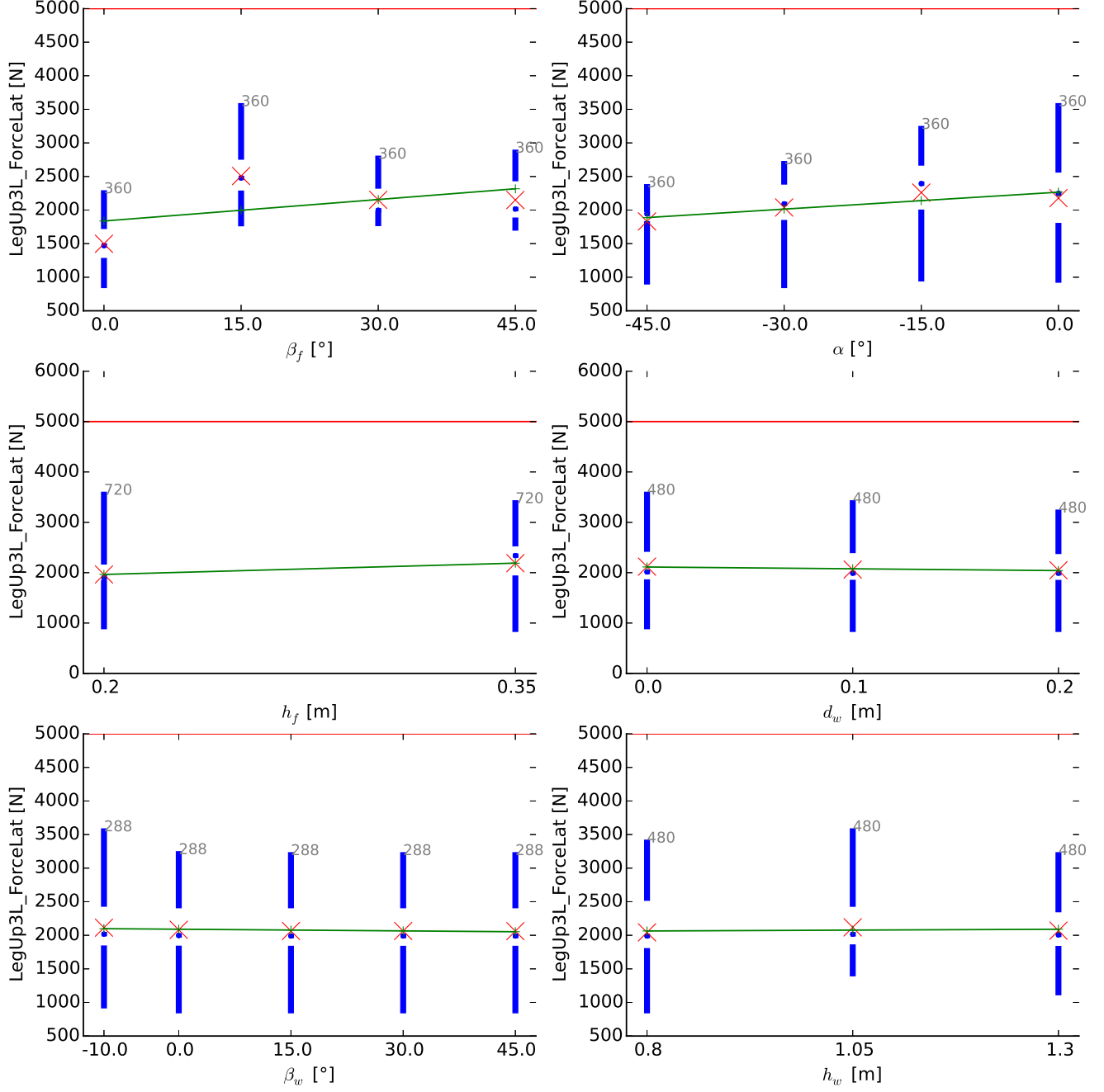


Figure 22: LegUp3L_ForceLat, M50 pedestrian, 20 km h⁻¹

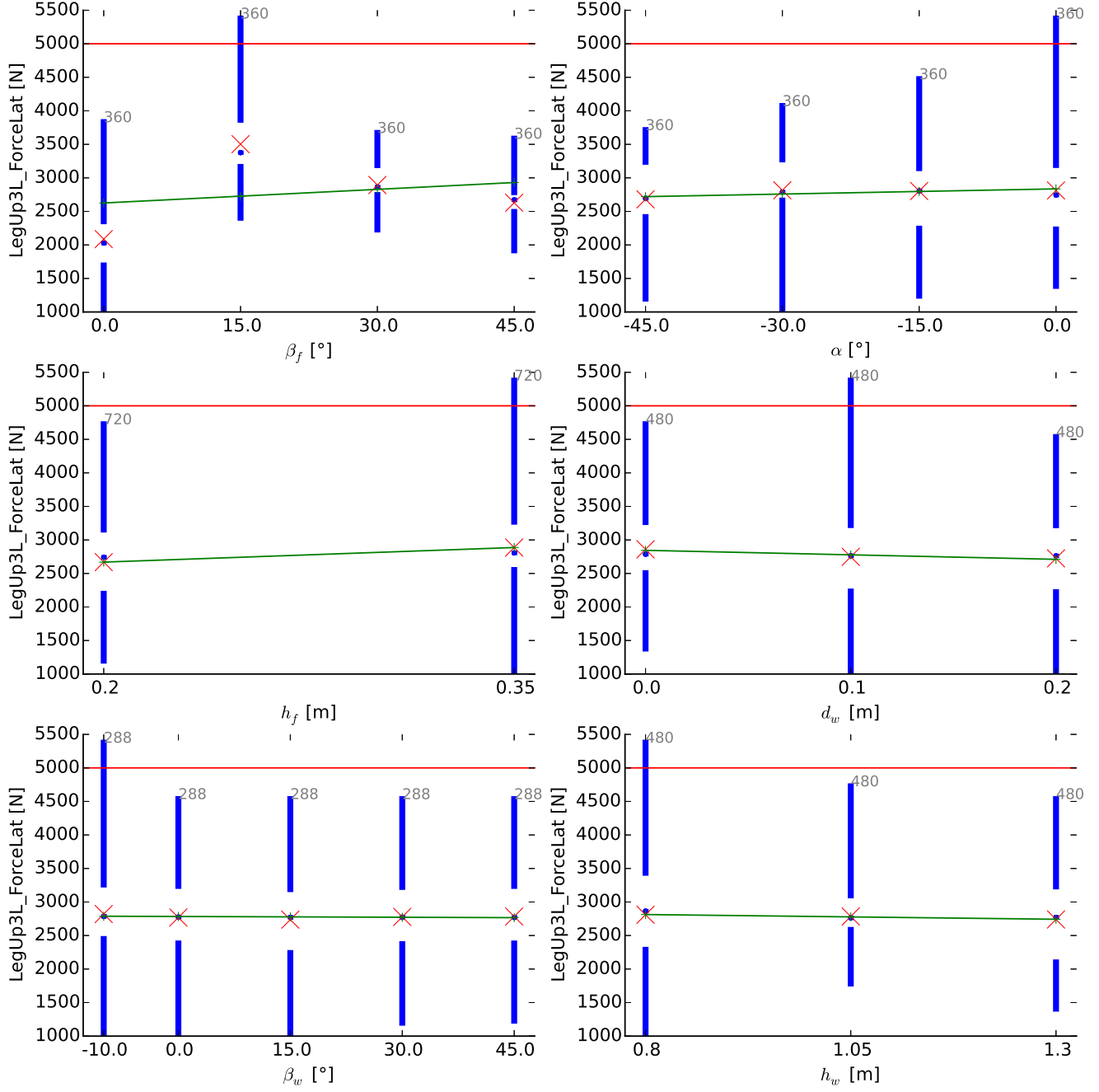


Figure 23: LegUp3L_ForceLat, M50 pedestrian, 30 km h⁻¹

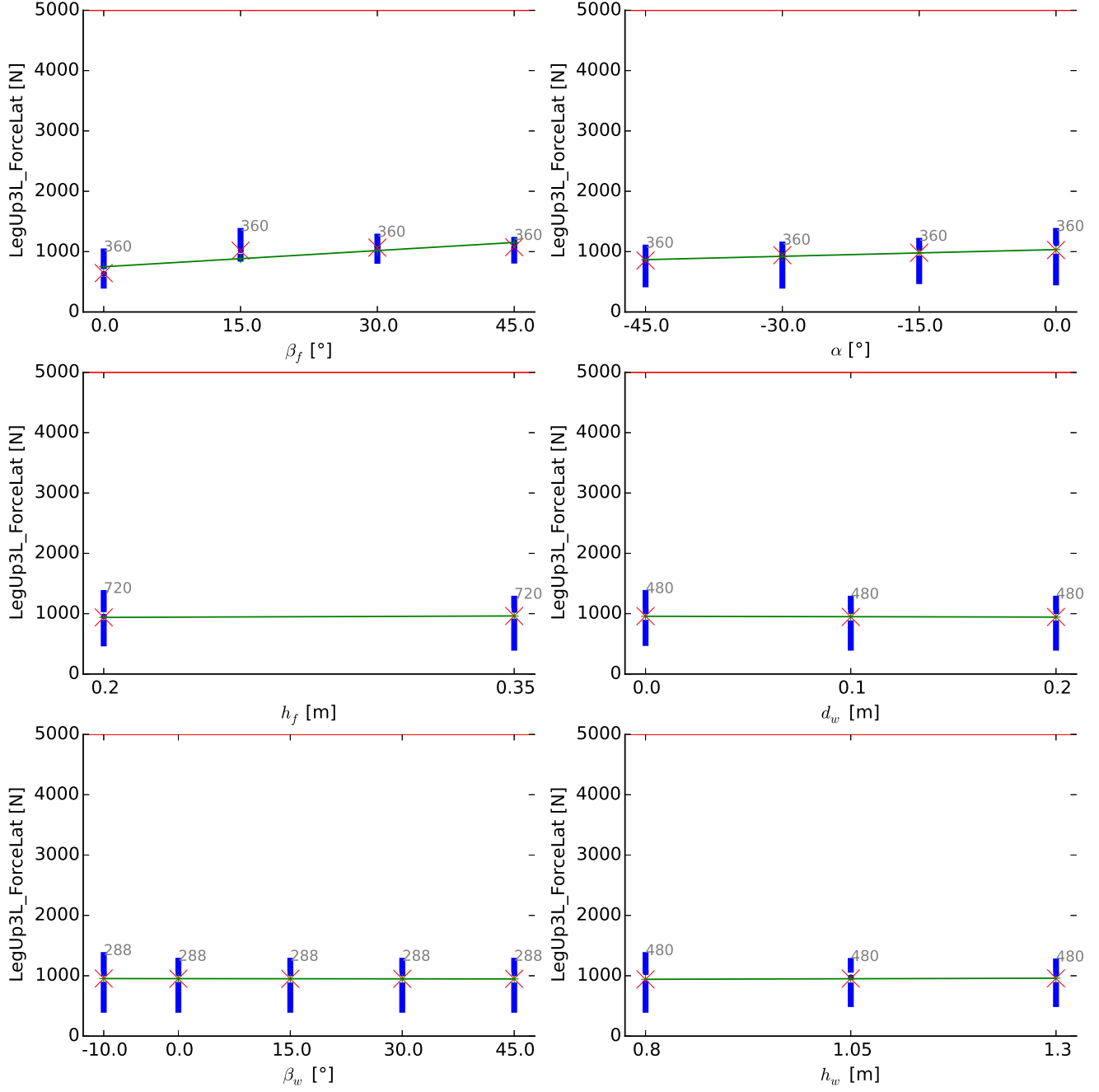


Figure 24: LegUp3L_ForceLat, C06 pedestrian, 20 km h⁻¹

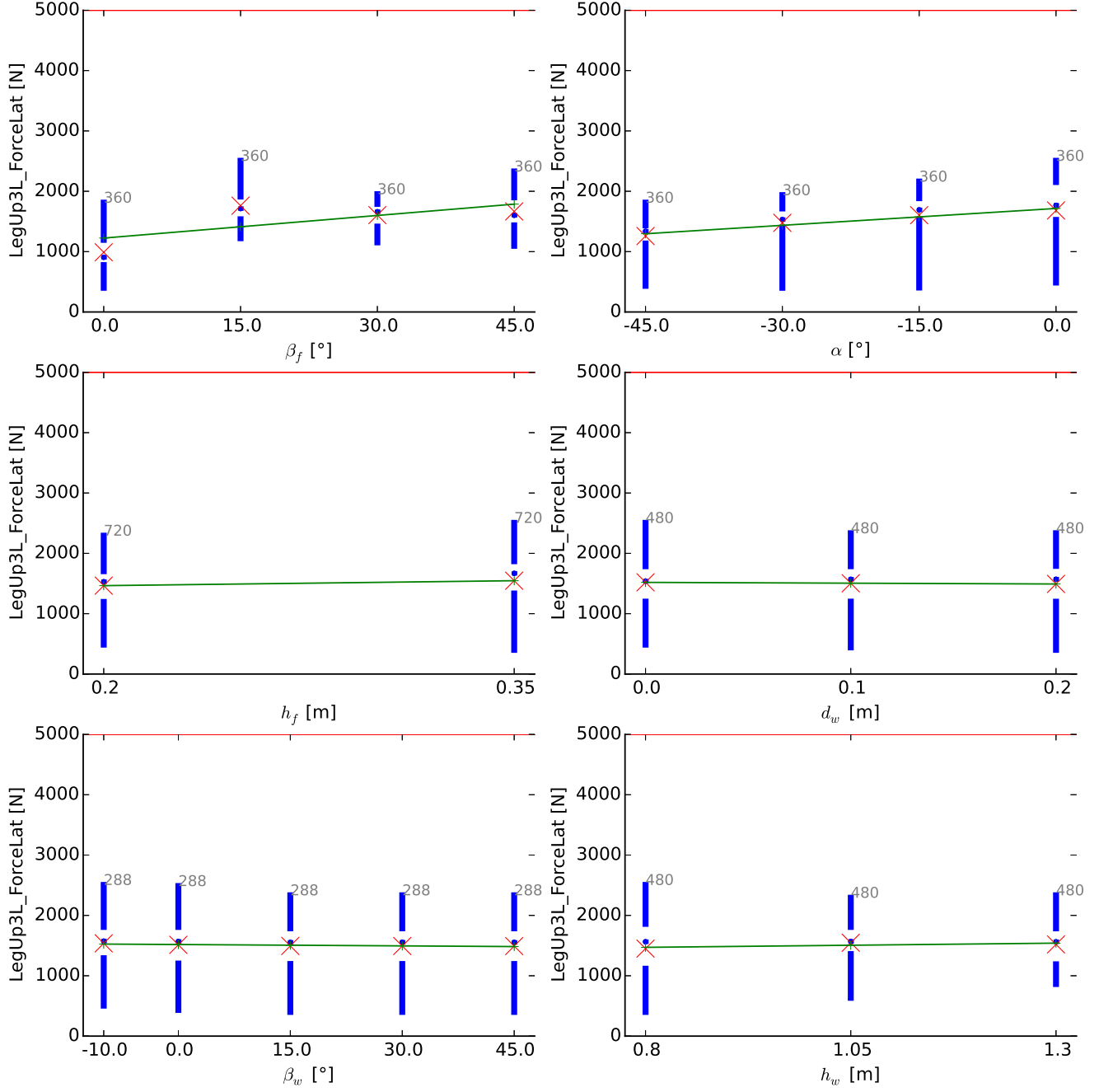


Figure 25: LegUp3L_ForceLat, F05 pedestrian, 20 km h⁻¹

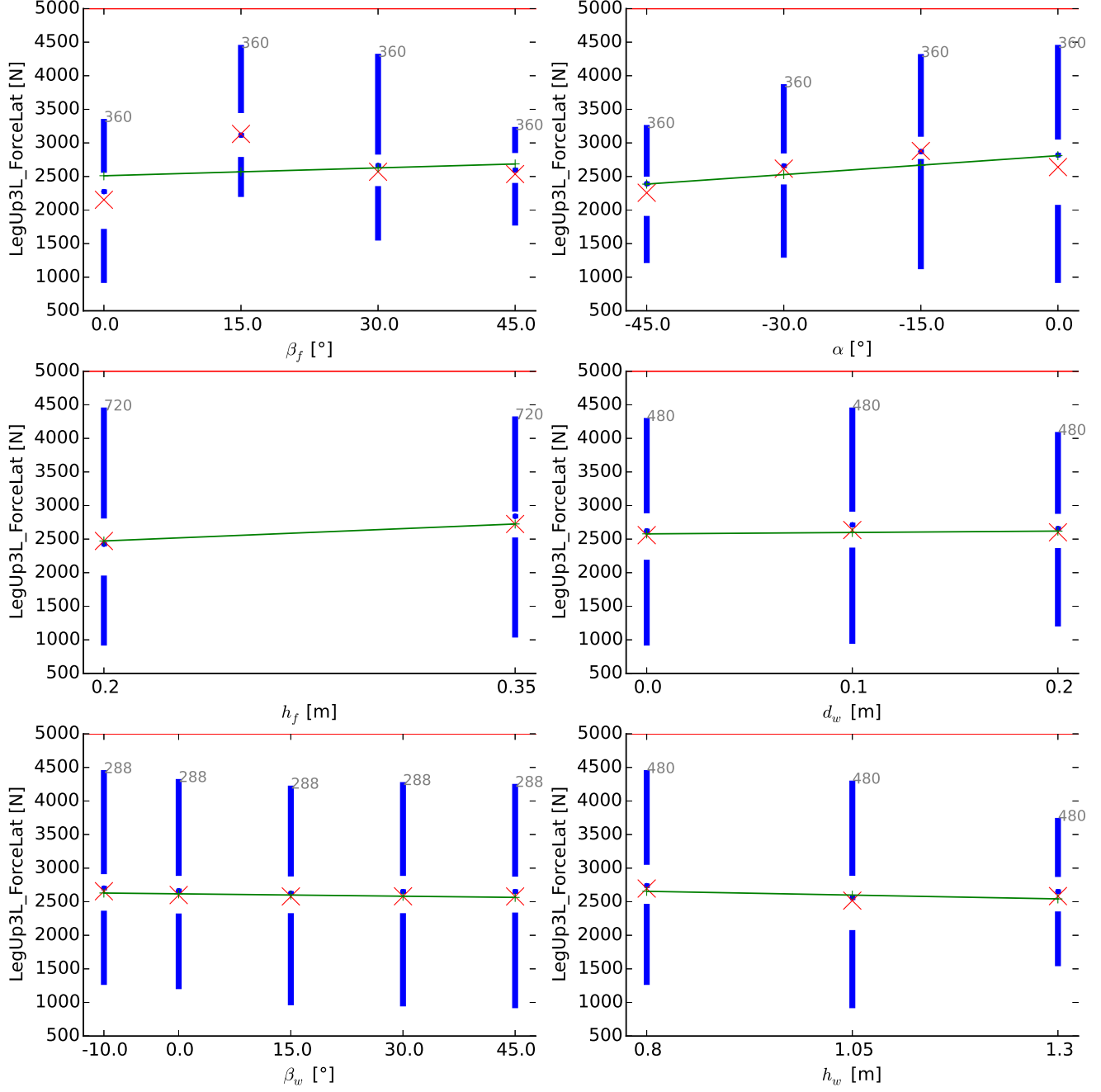


Figure 26: LegUp3L_ForceLat, M95 pedestrian, 20 km h⁻¹

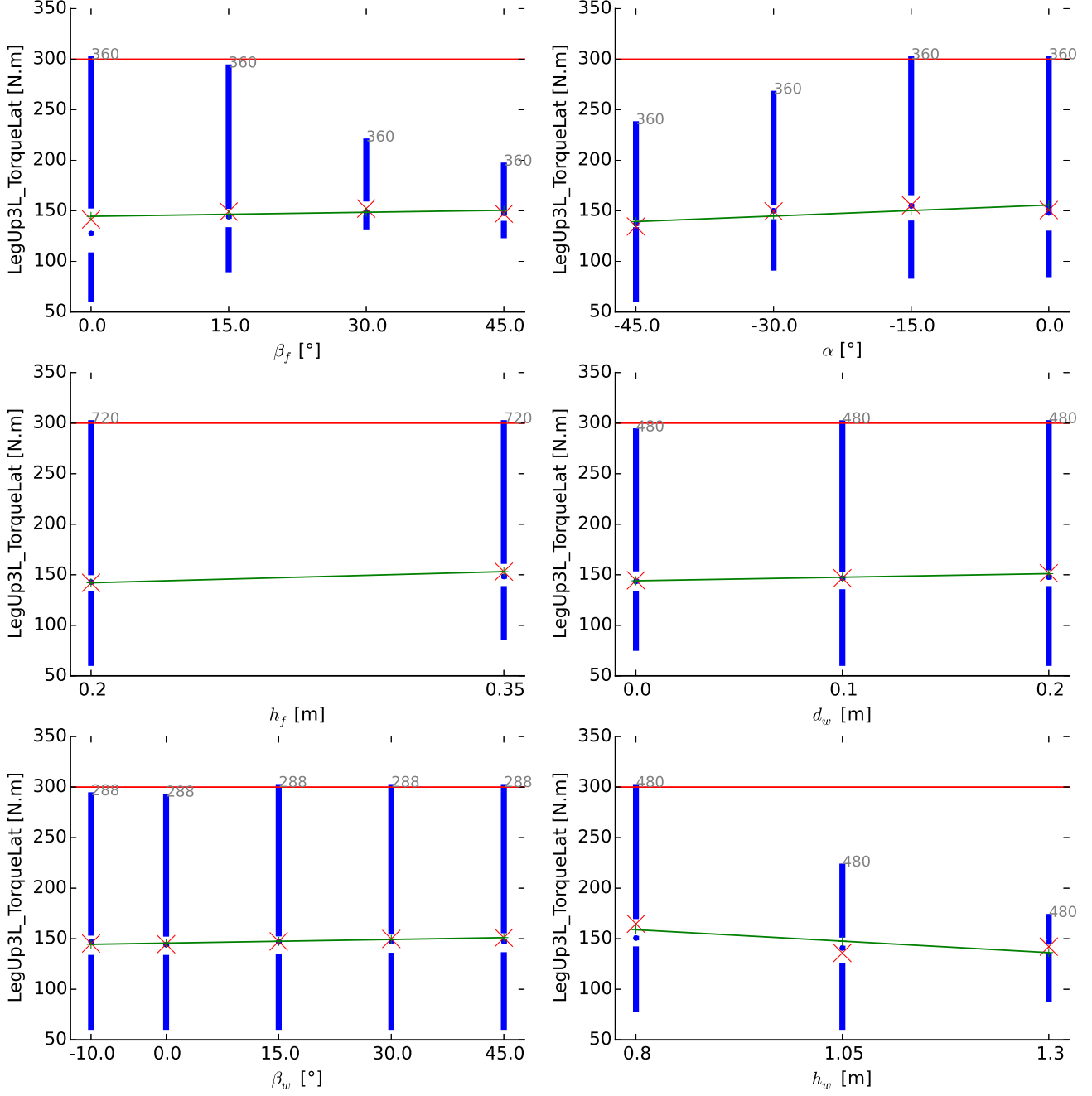


Figure 27: LegUp3L_TorqueLat, M50 pedestrian, 20 km h⁻¹

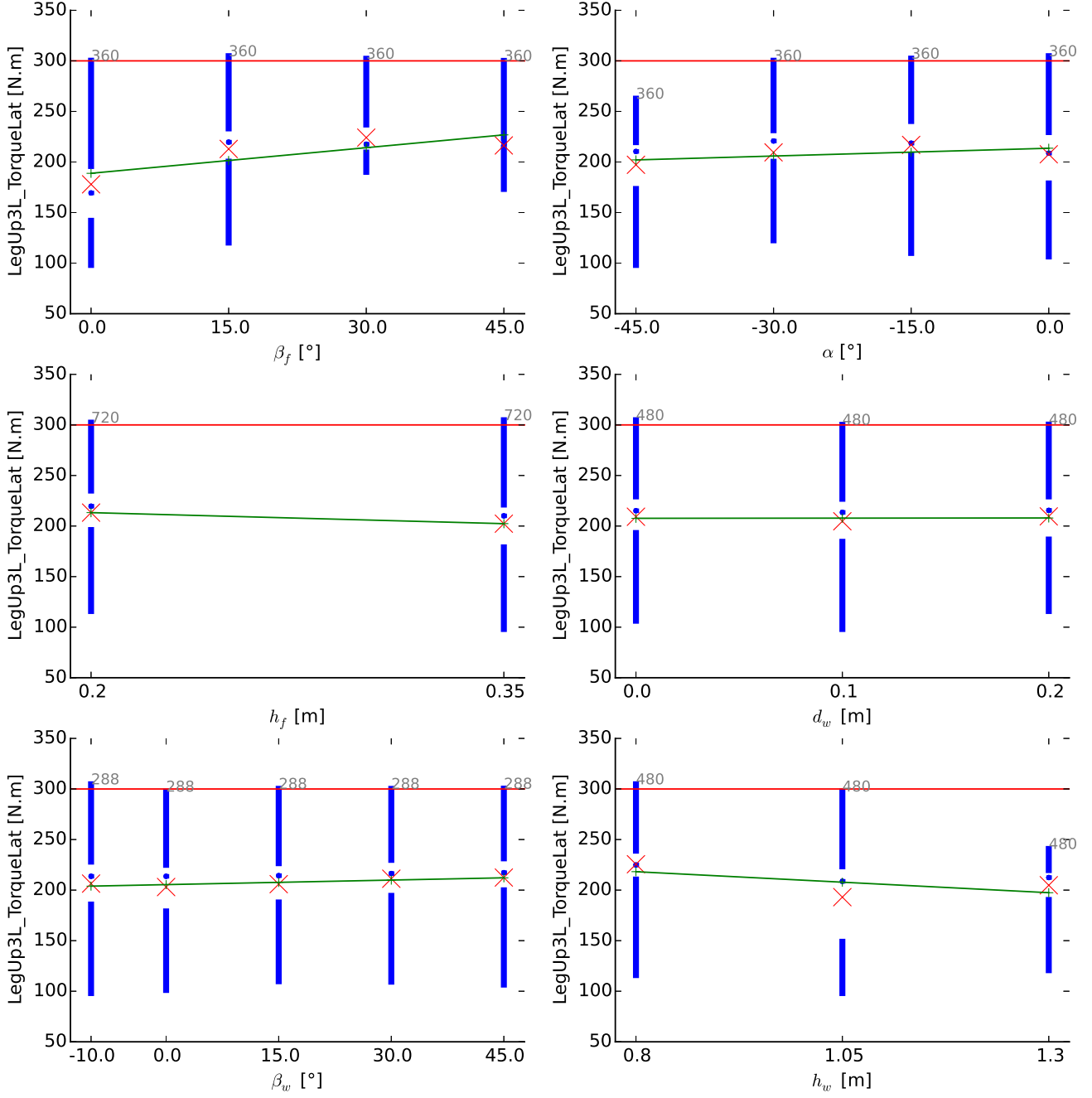


Figure 28: LegUp3L_TorqueLat, M50 pedestrian, 30 km h⁻¹

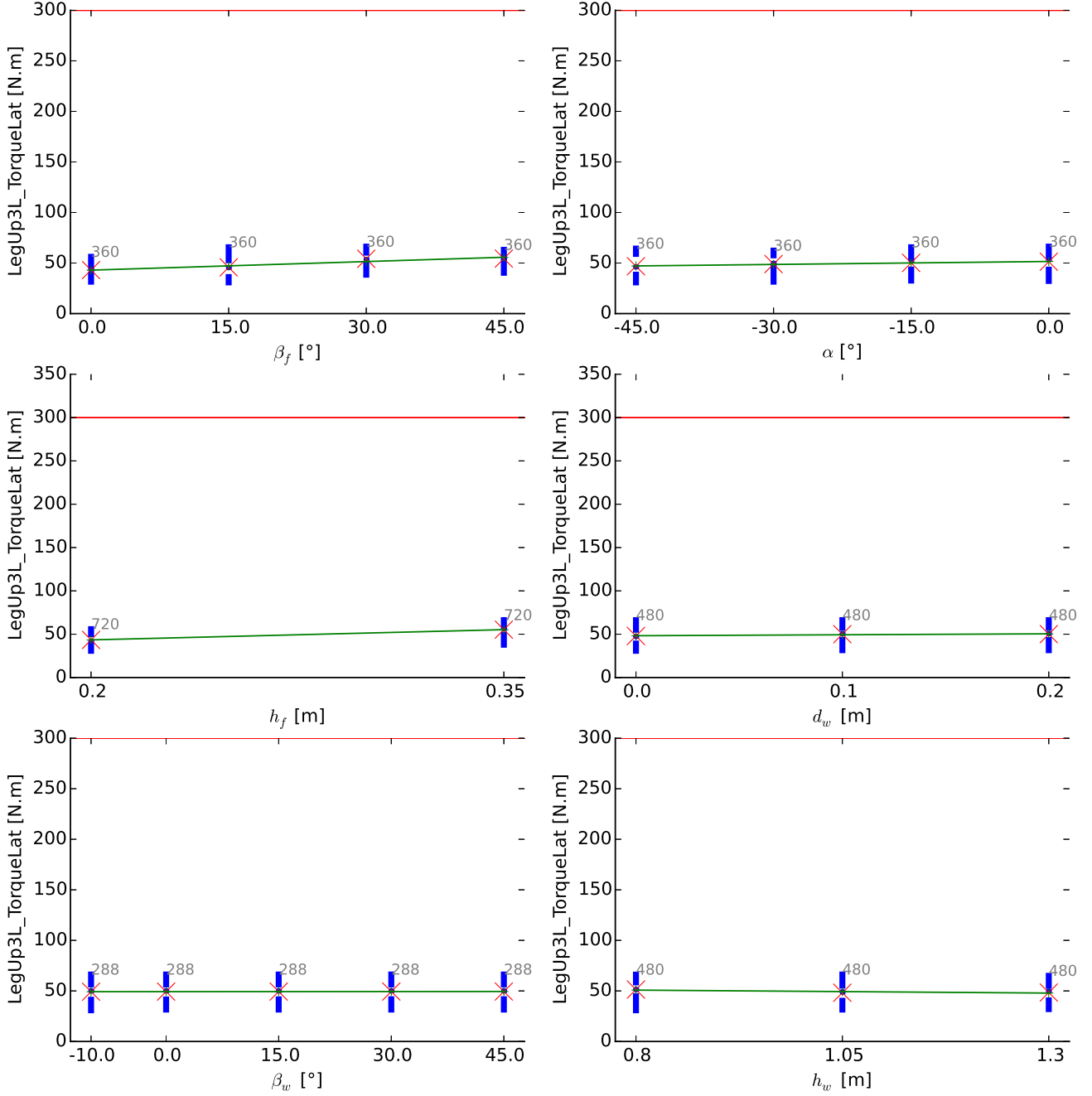


Figure 29: LegUp3L_TorqueLat, C06 pedestrian, 20 km h⁻¹

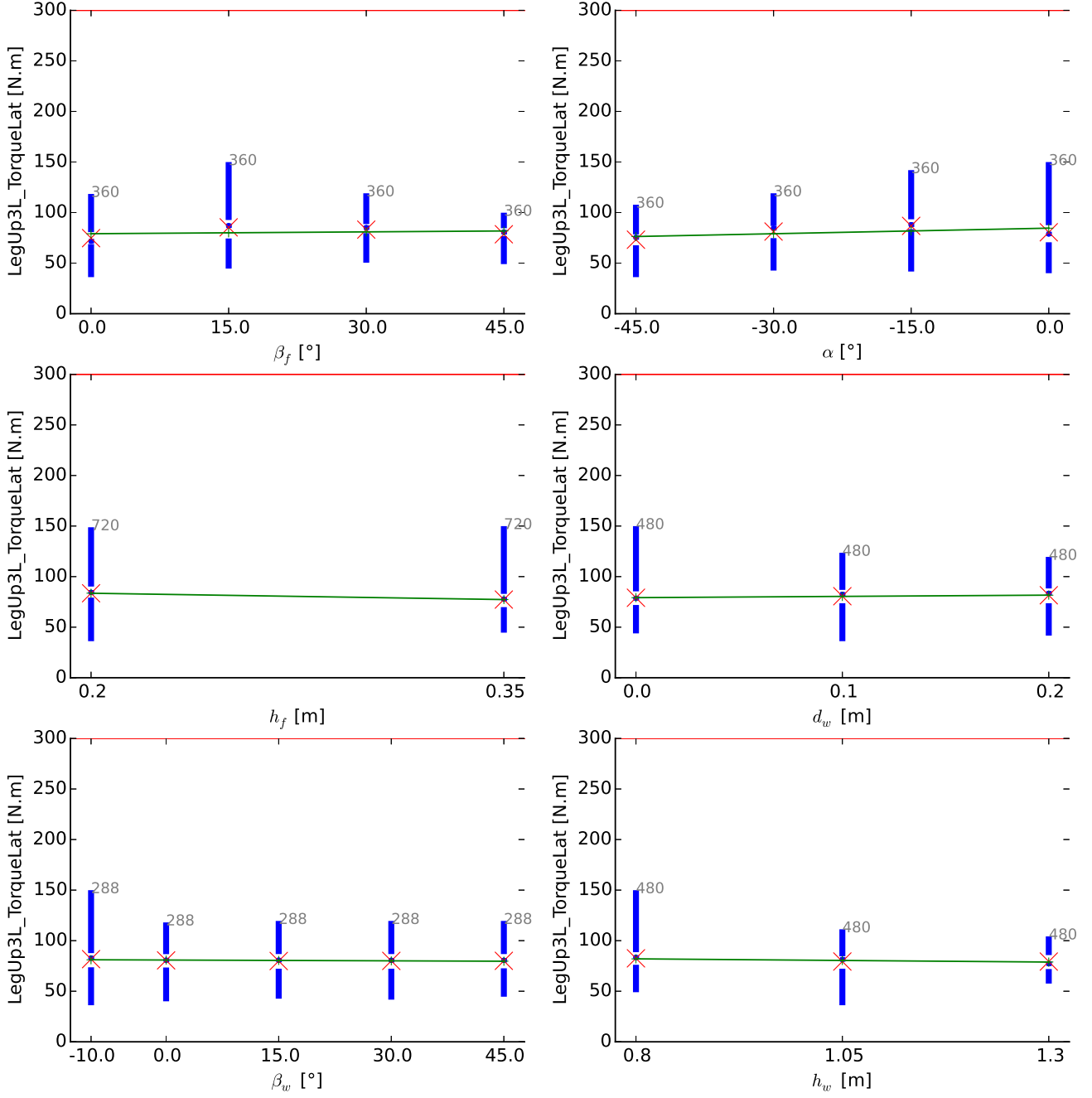


Figure 30: LegUp3L_TorqueLat, F05 pedestrian, 20 km h⁻¹

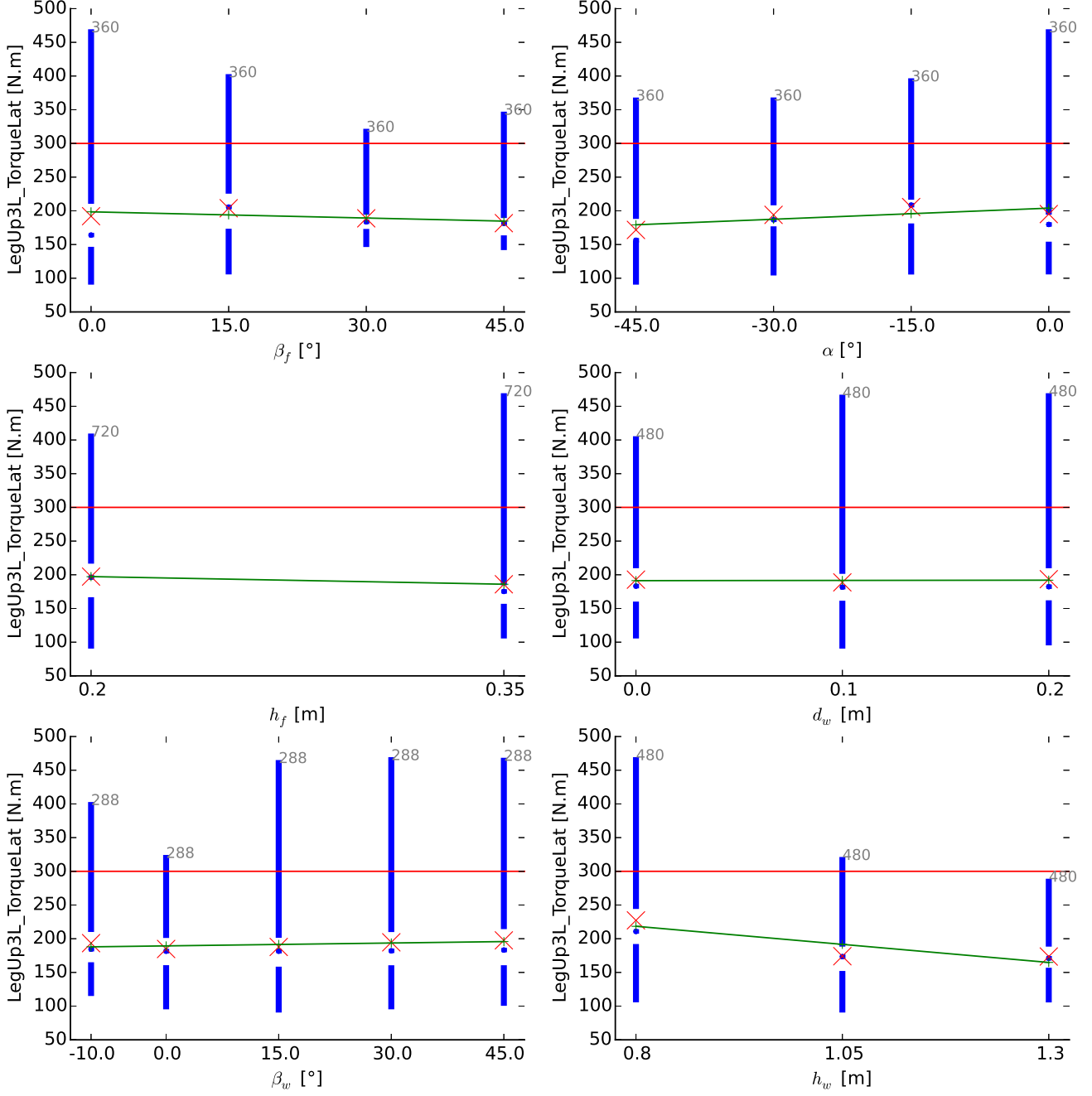


Figure 31: LegUp3L_TorqueLat, M95 pedestrian, 20 km h⁻¹

5 Knee injury

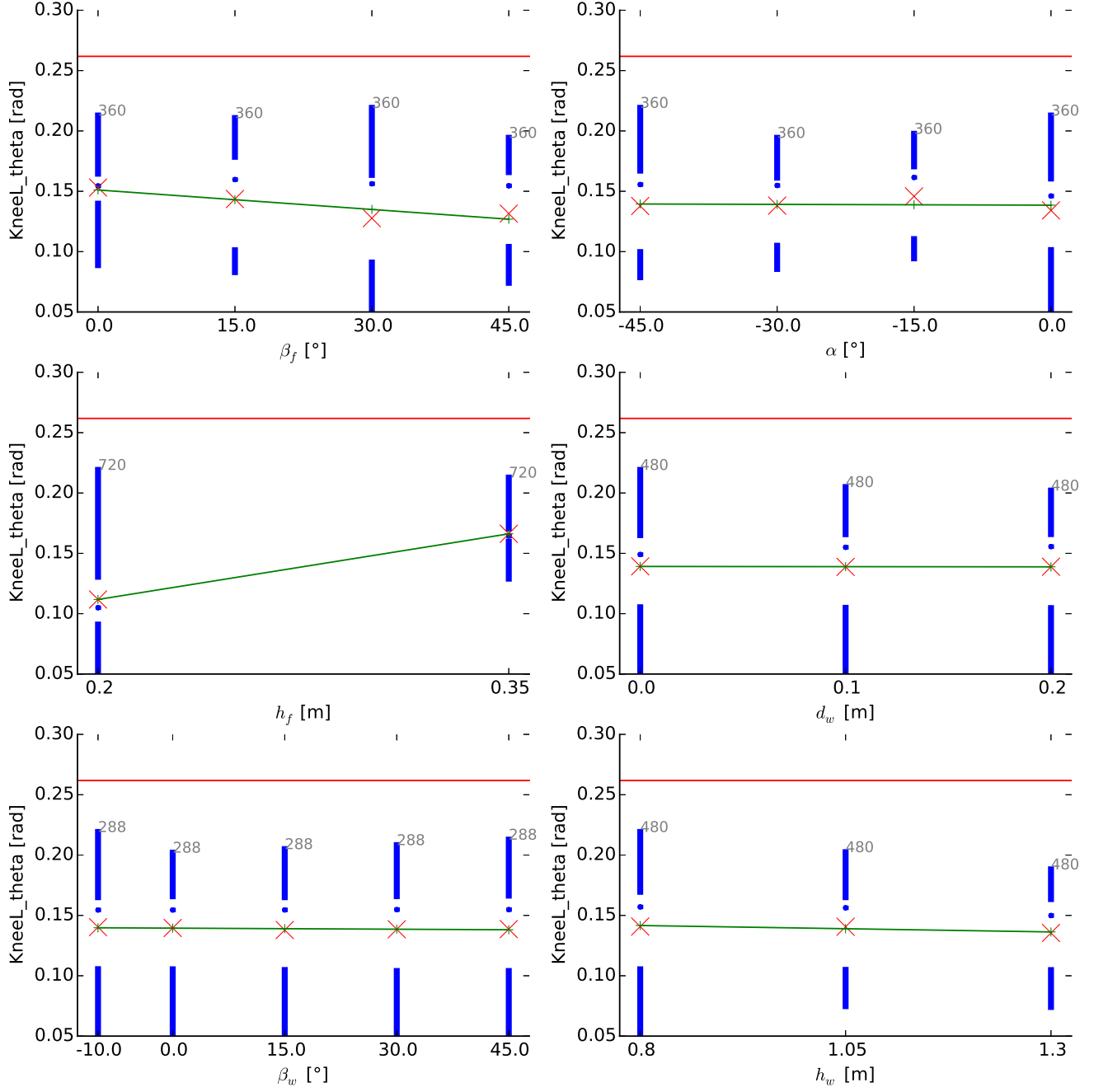


Figure 32: KneeL_theta, M50 pedestrian, 20 km h⁻¹

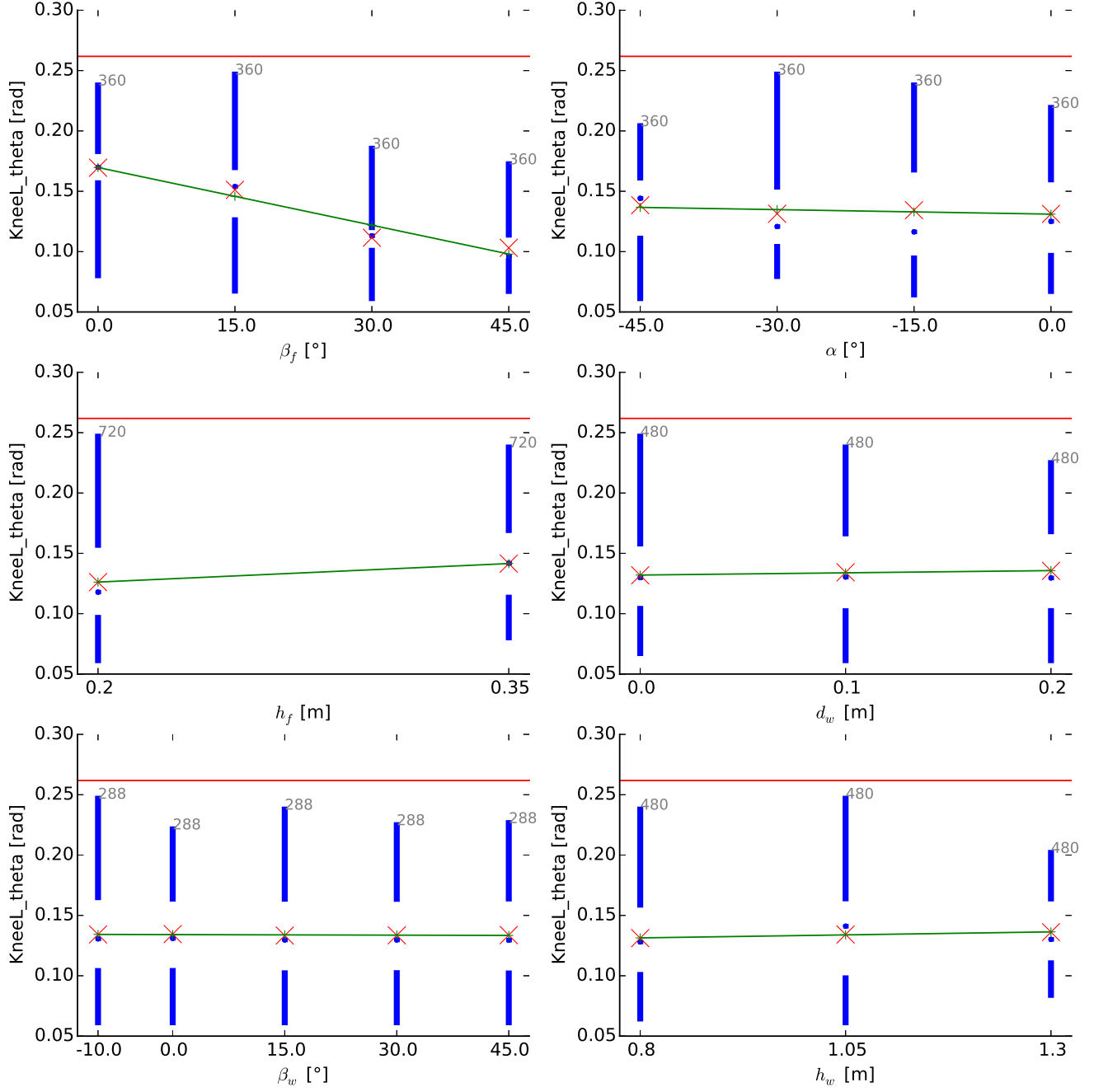


Figure 33: Kneel_theta, M50 pedestrian, 30 km h^{-1}

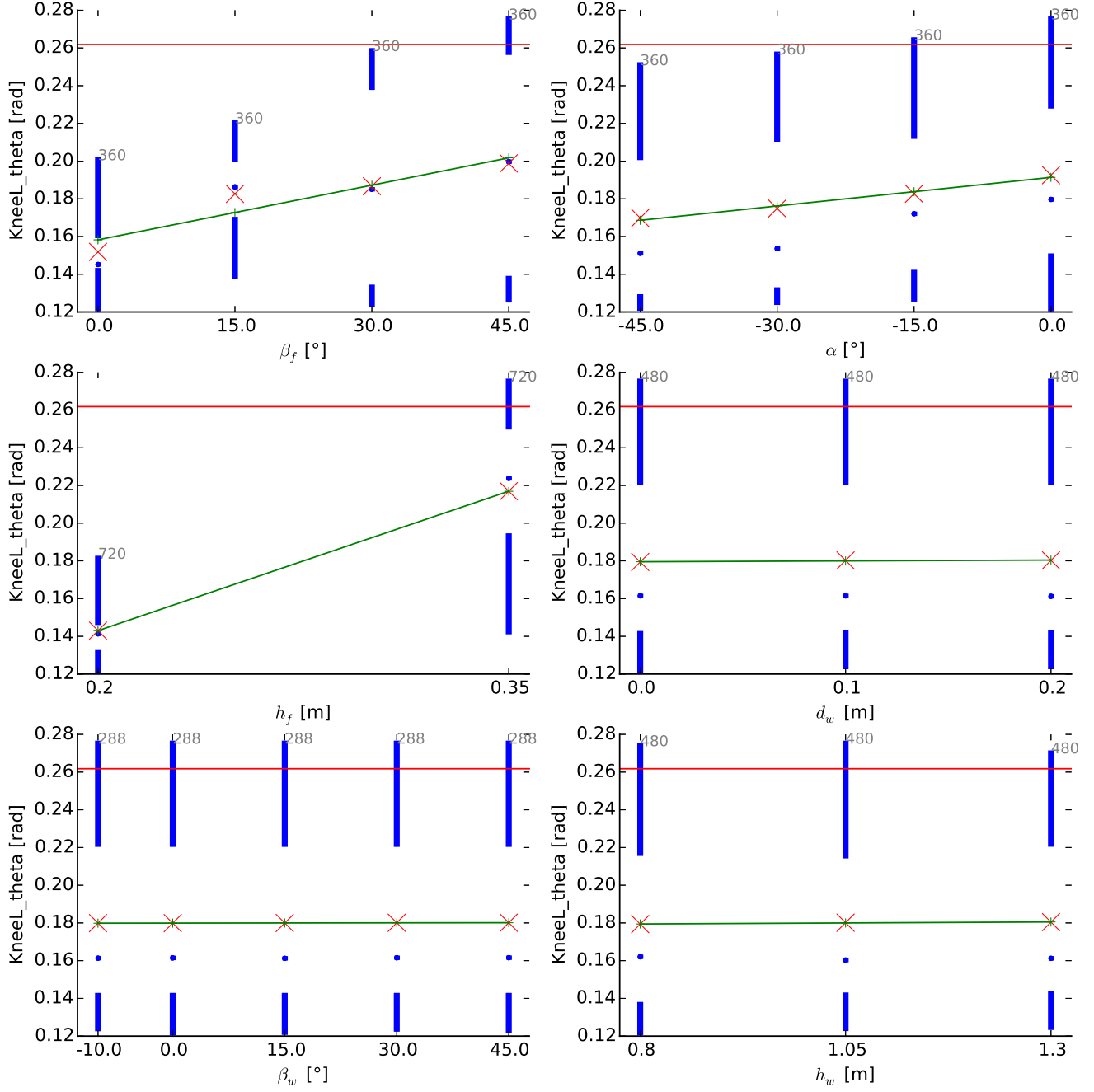


Figure 34: Kneel_theta, C06 pedestrian, 20 km h^{-1}

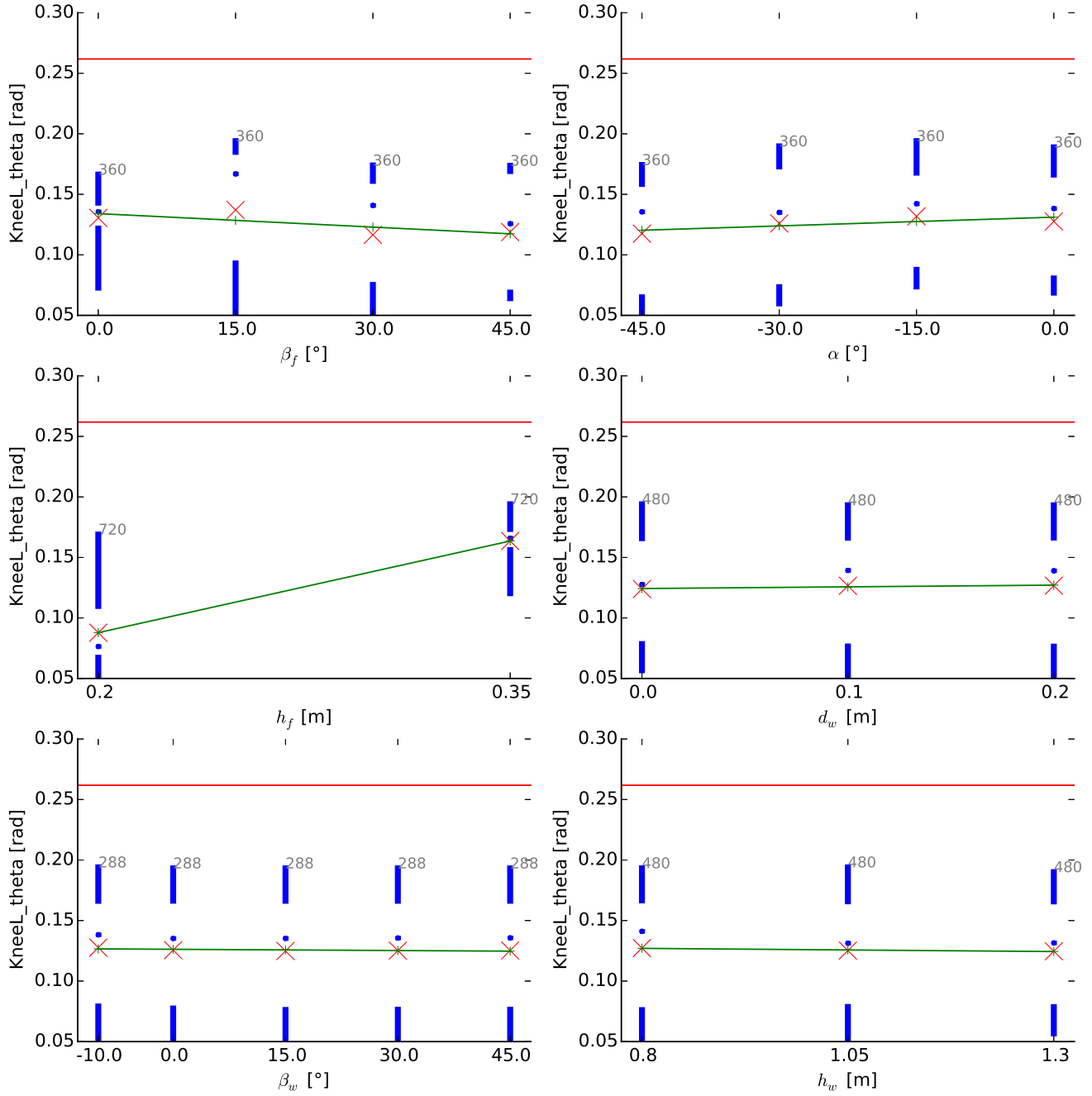


Figure 35: KneeL_theta, F05 pedestrian, 20 km h⁻¹

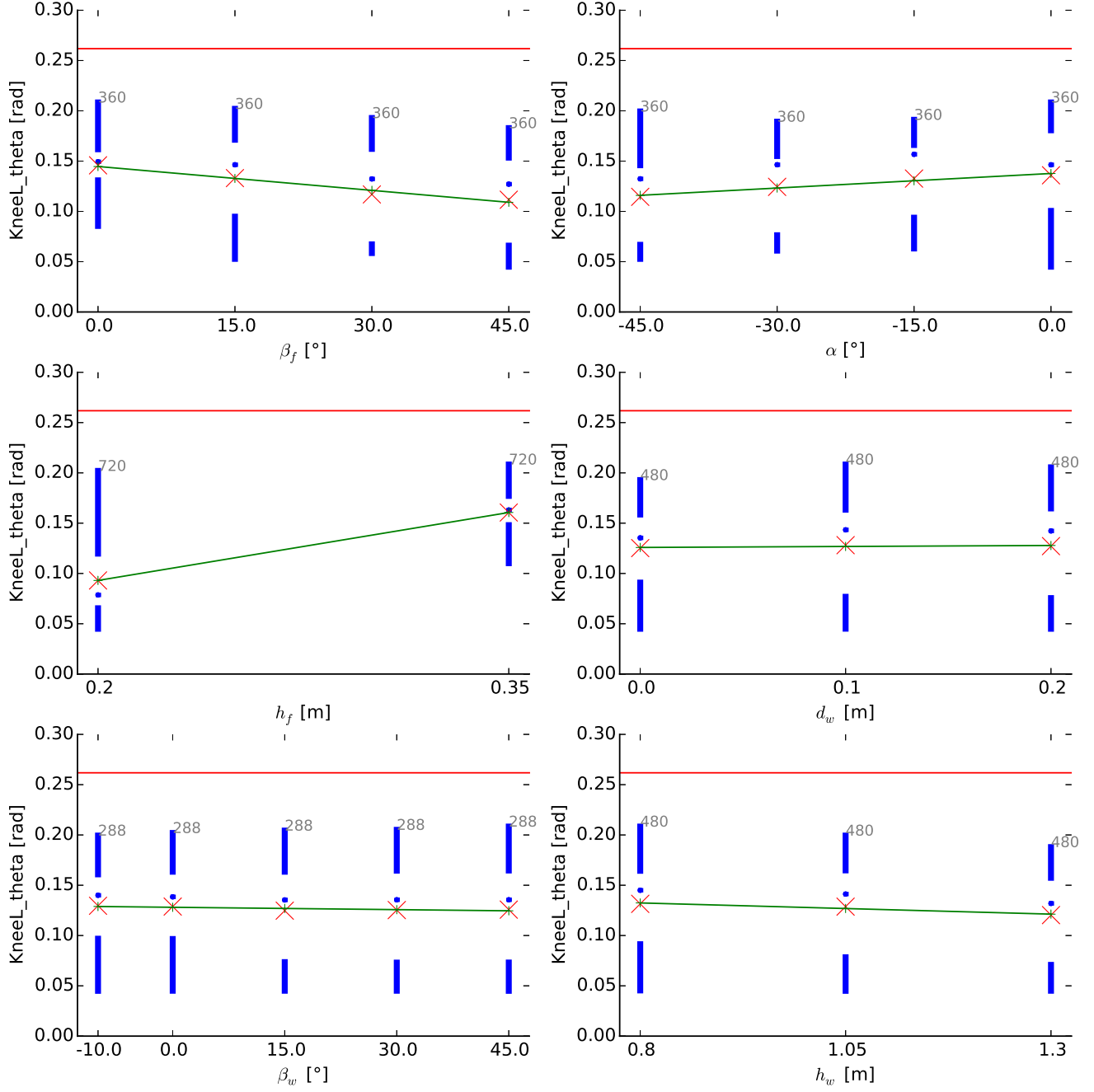


Figure 36: KneeL_theta, M95 pedestrian, 20 km h⁻¹

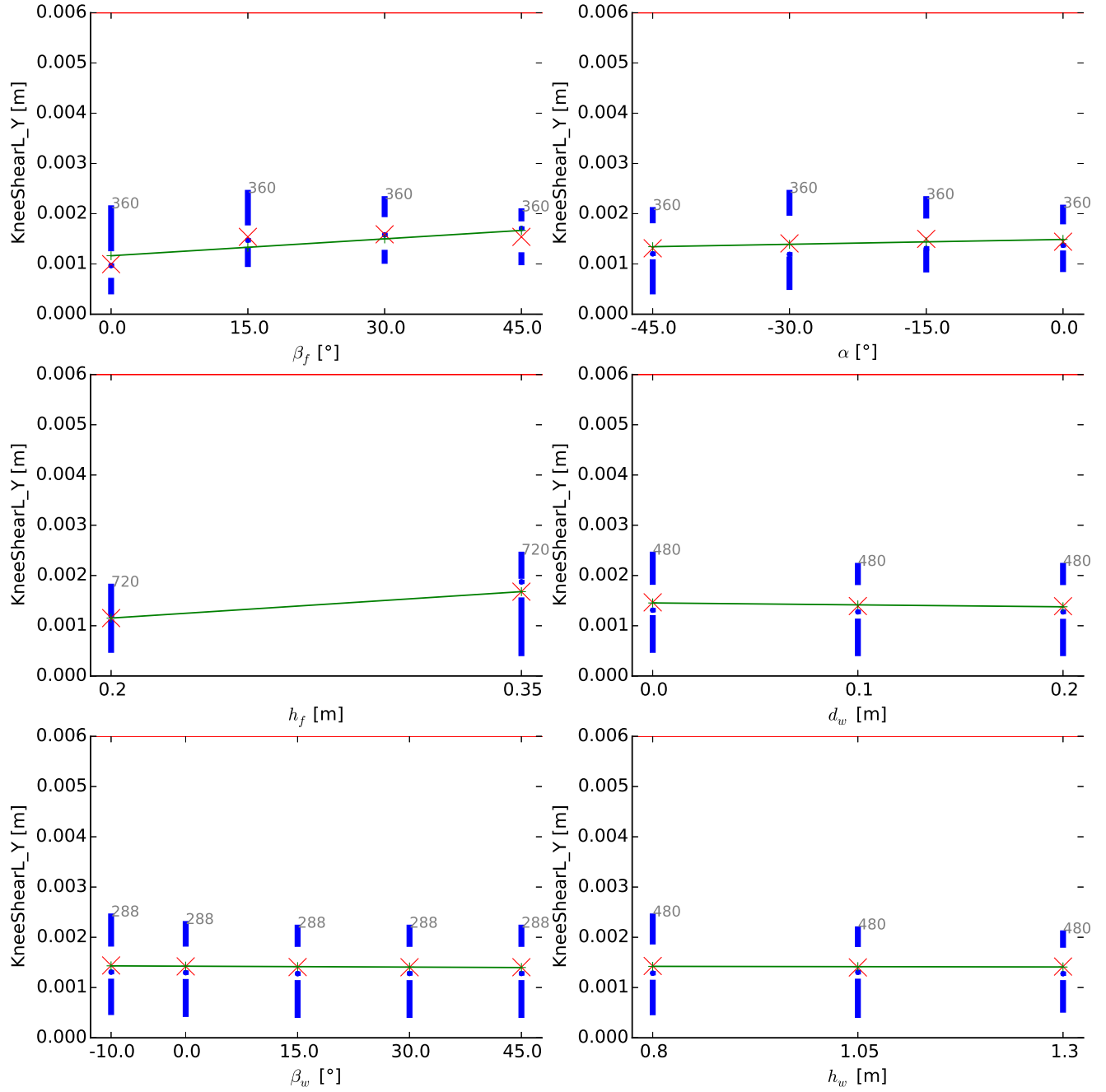


Figure 37: KneeShearL_Y, M50 pedestrian, 20 km h⁻¹

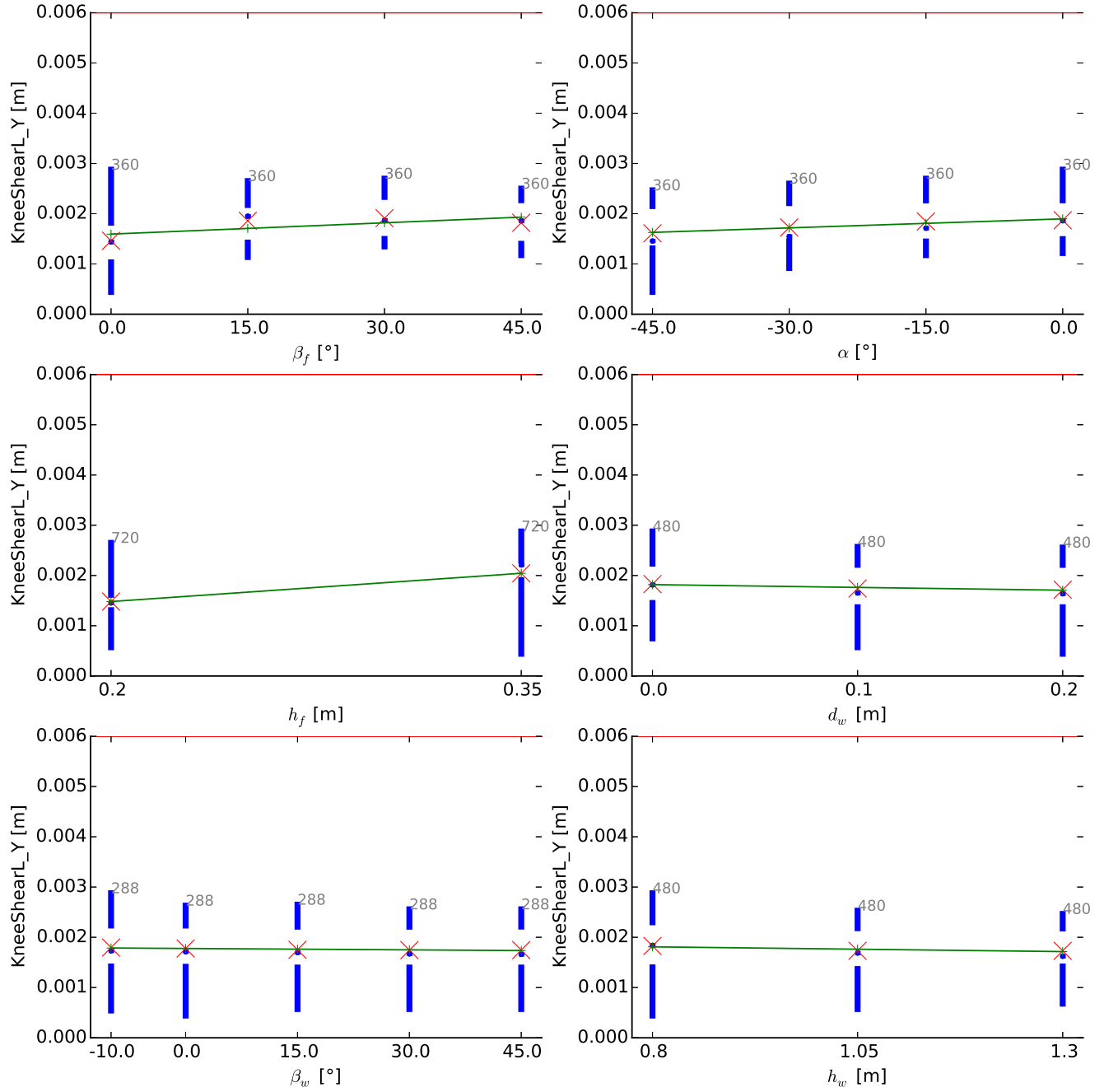


Figure 38: KneeShearL_Y, M50 pedestrian, 30 km h⁻¹

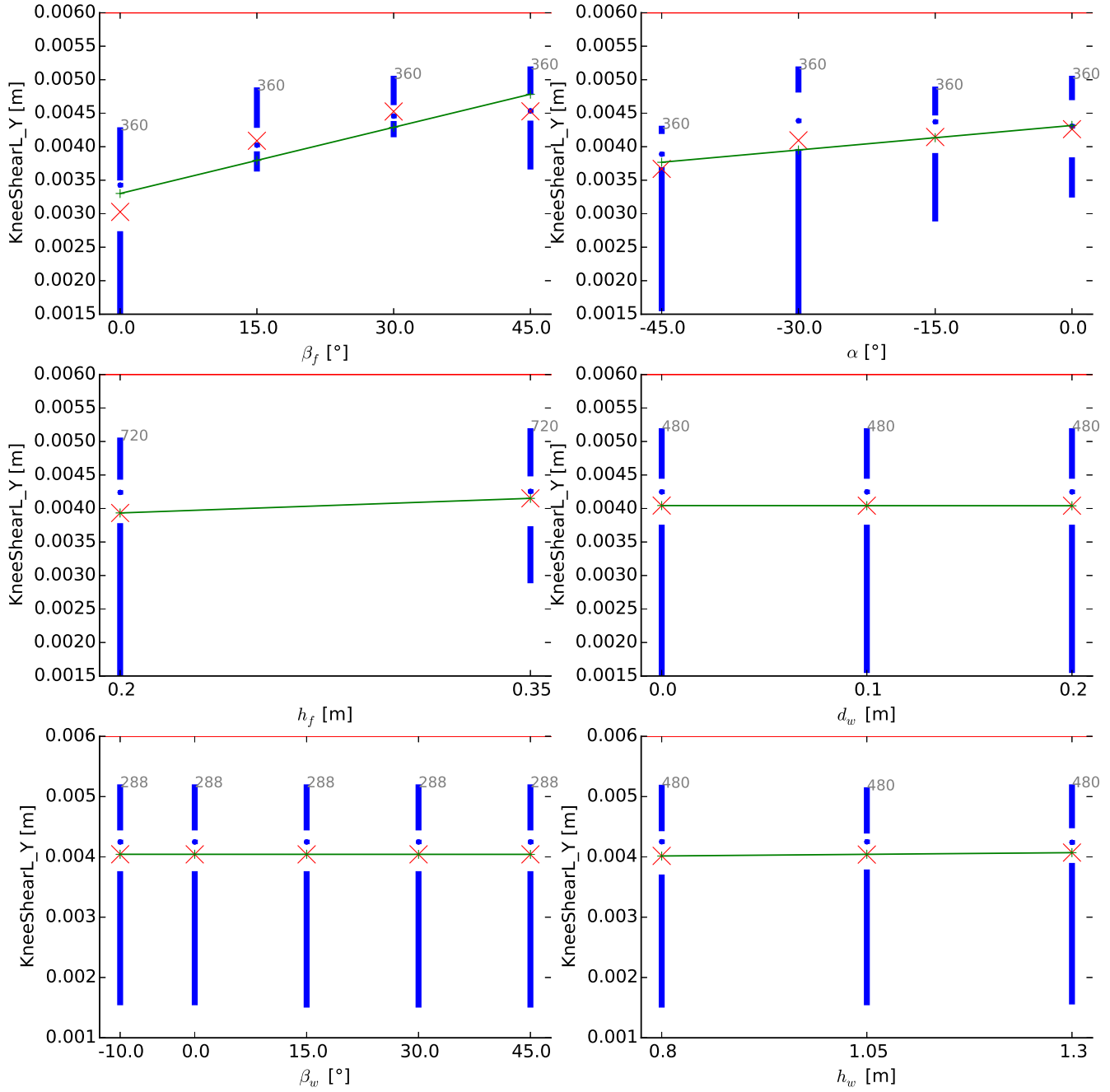


Figure 39: KneeShearL_Y, C06 pedestrian, 20 km h⁻¹

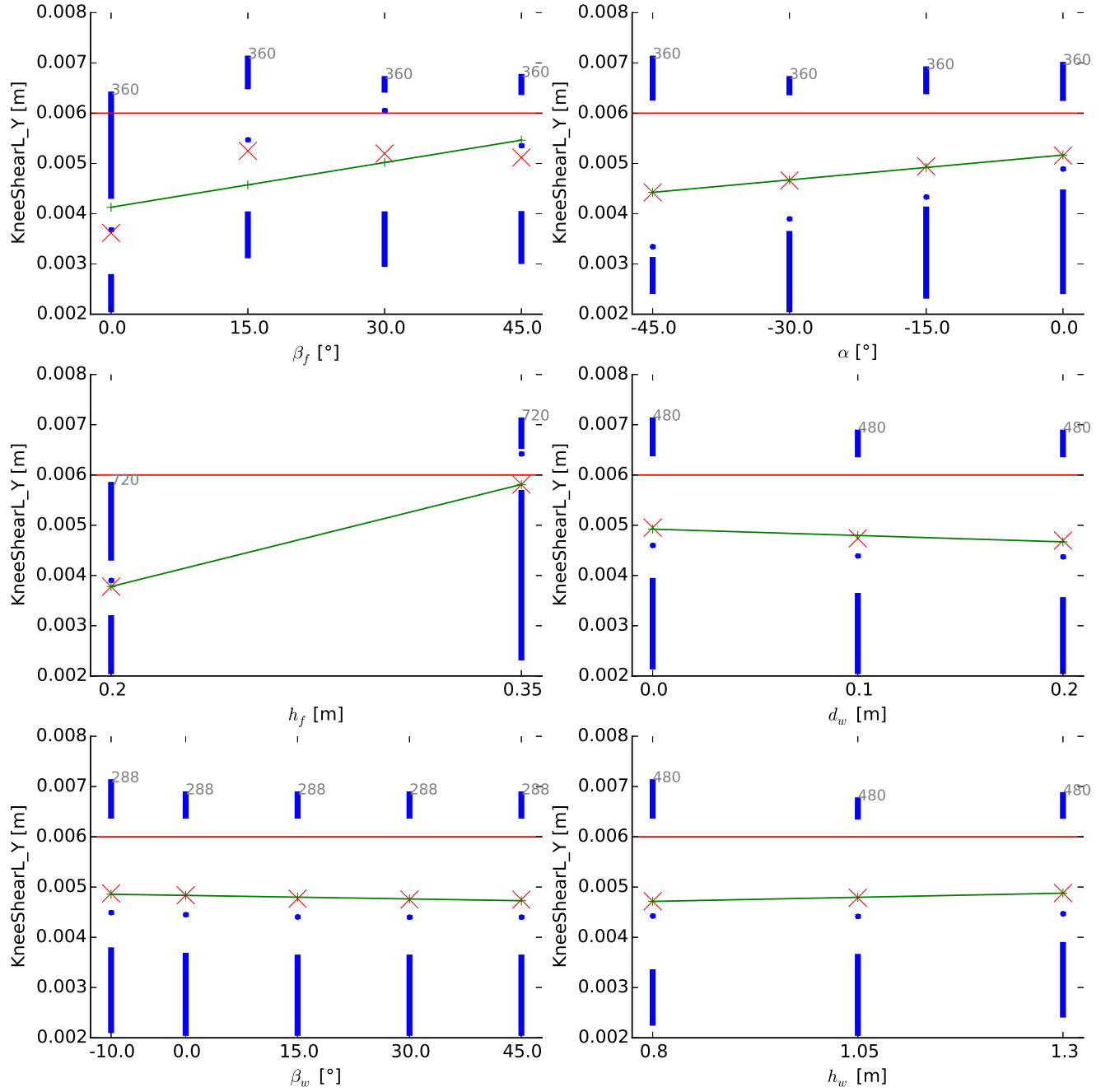


Figure 40: KneeShearL_Y, F05 pedestrian, 20 km h⁻¹

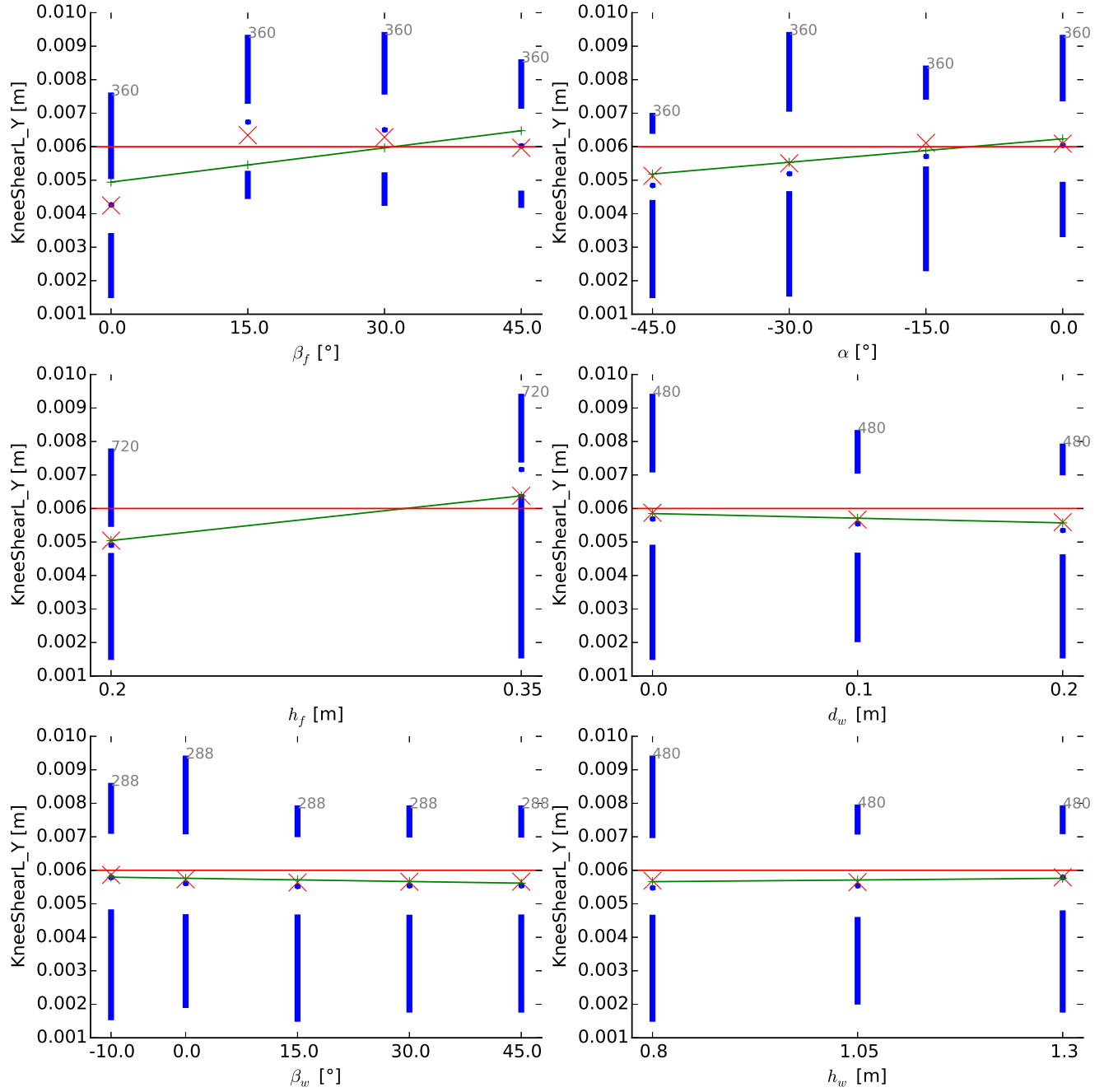


Figure 41: KneeShearL_Y, M95 pedestrian, 20 km h⁻¹

6 Tibia in jury

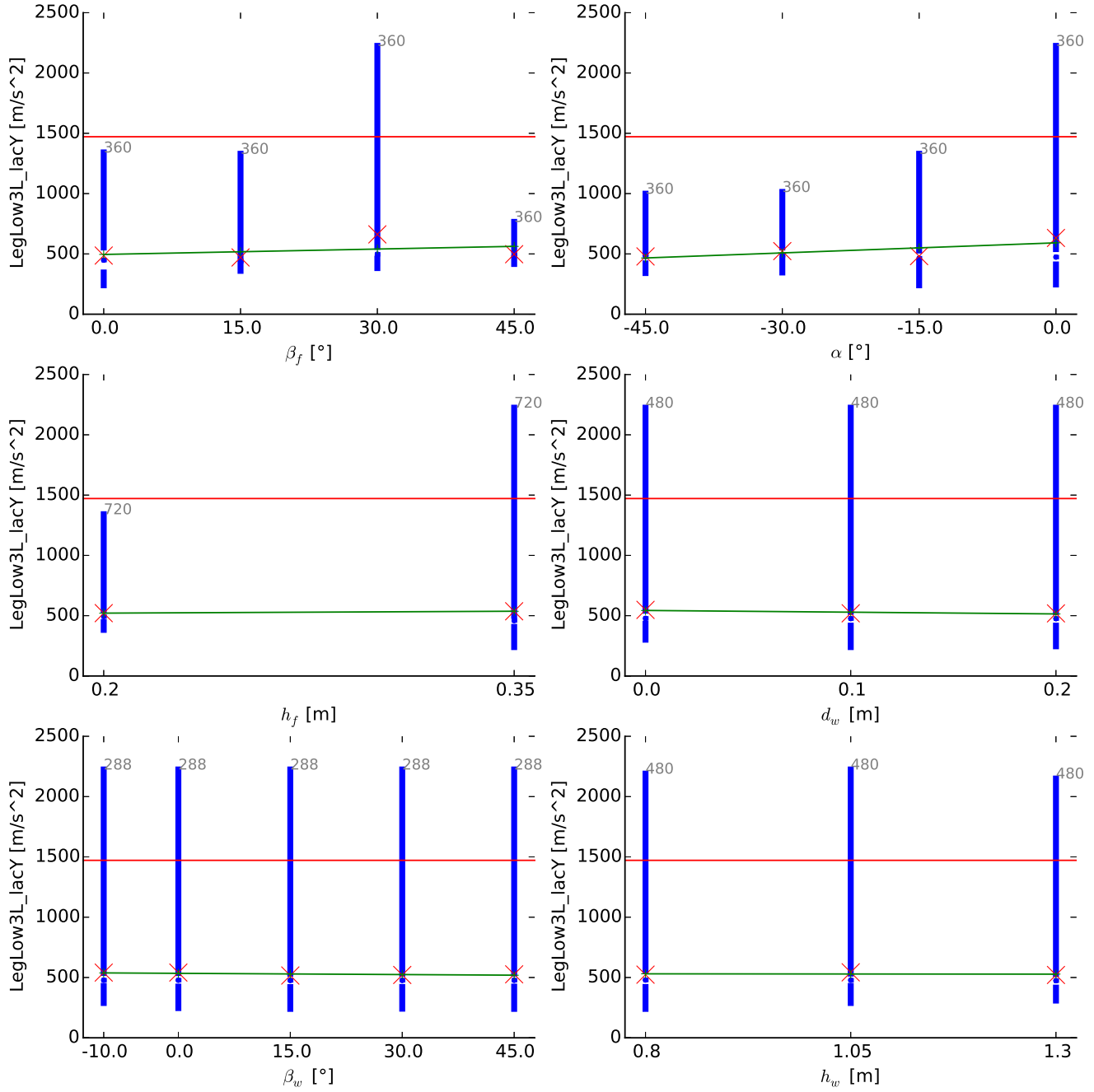


Figure 42: LegLow3L_lacY, M50 pedestrian, 20 km h⁻¹

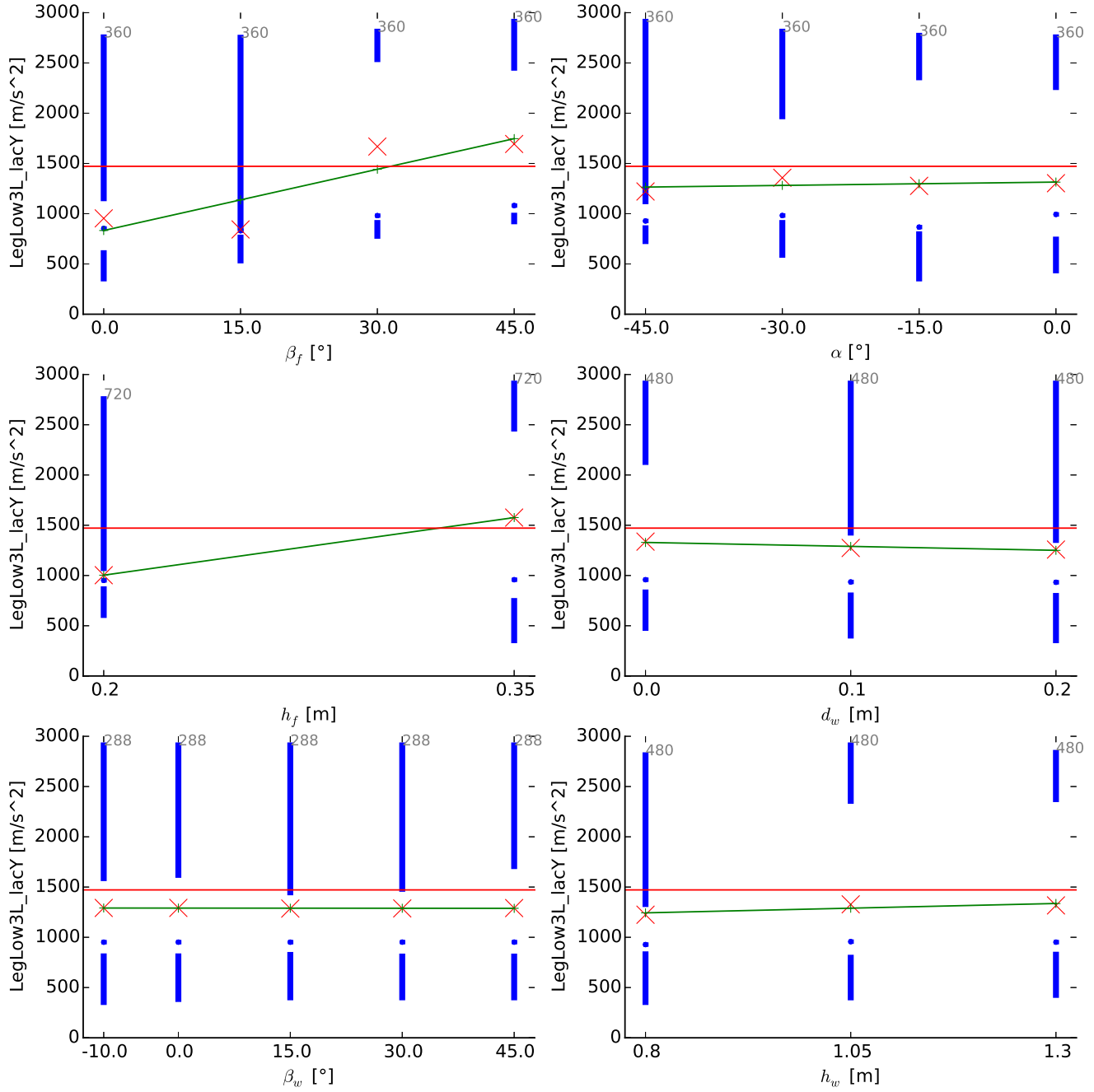


Figure 43: LegLow3L_lacY, M50 pedestrian, 30 km h⁻¹

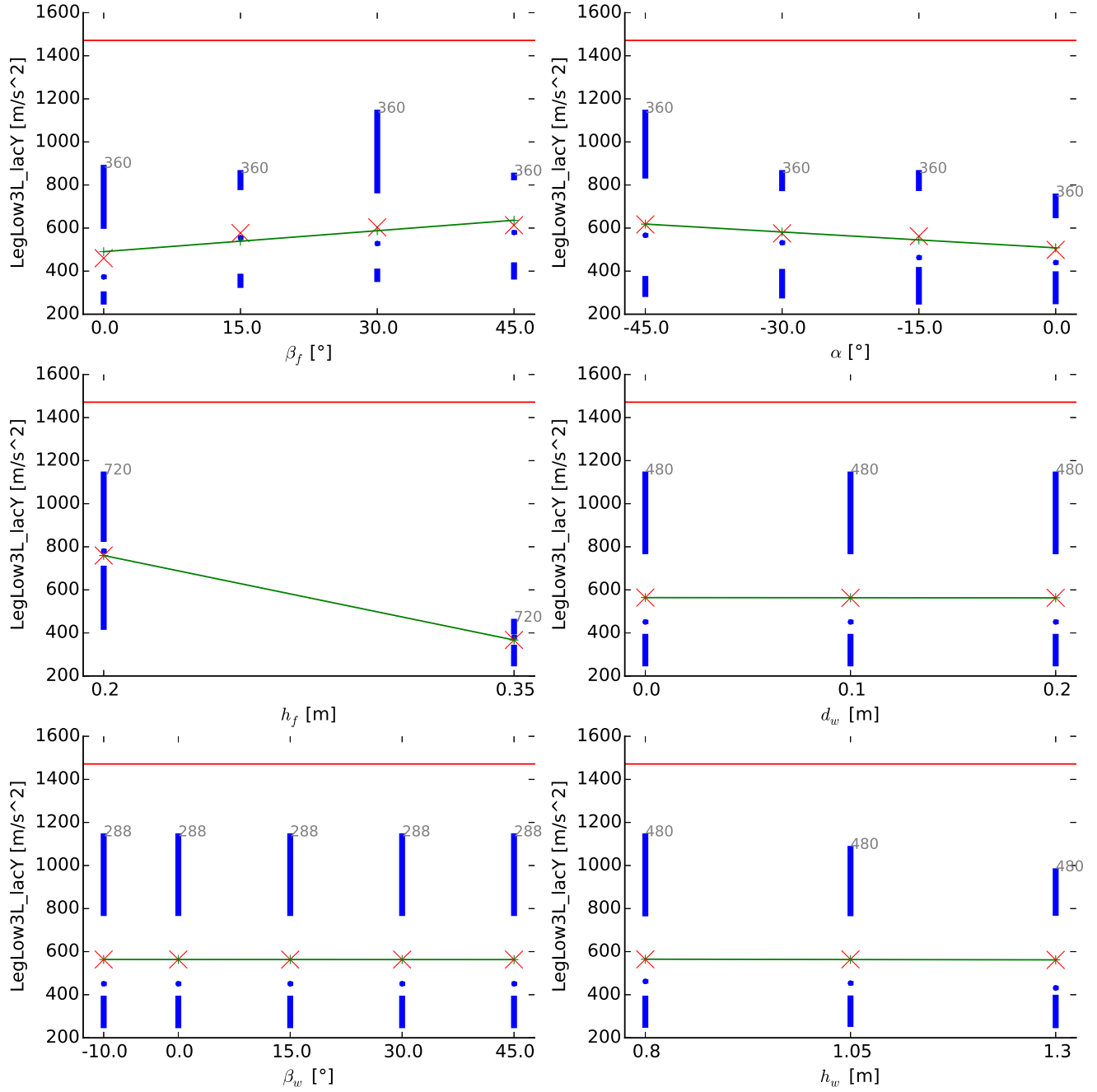


Figure 44: LegLow3L_lacY, C06 pedestrian, 20 km h⁻¹

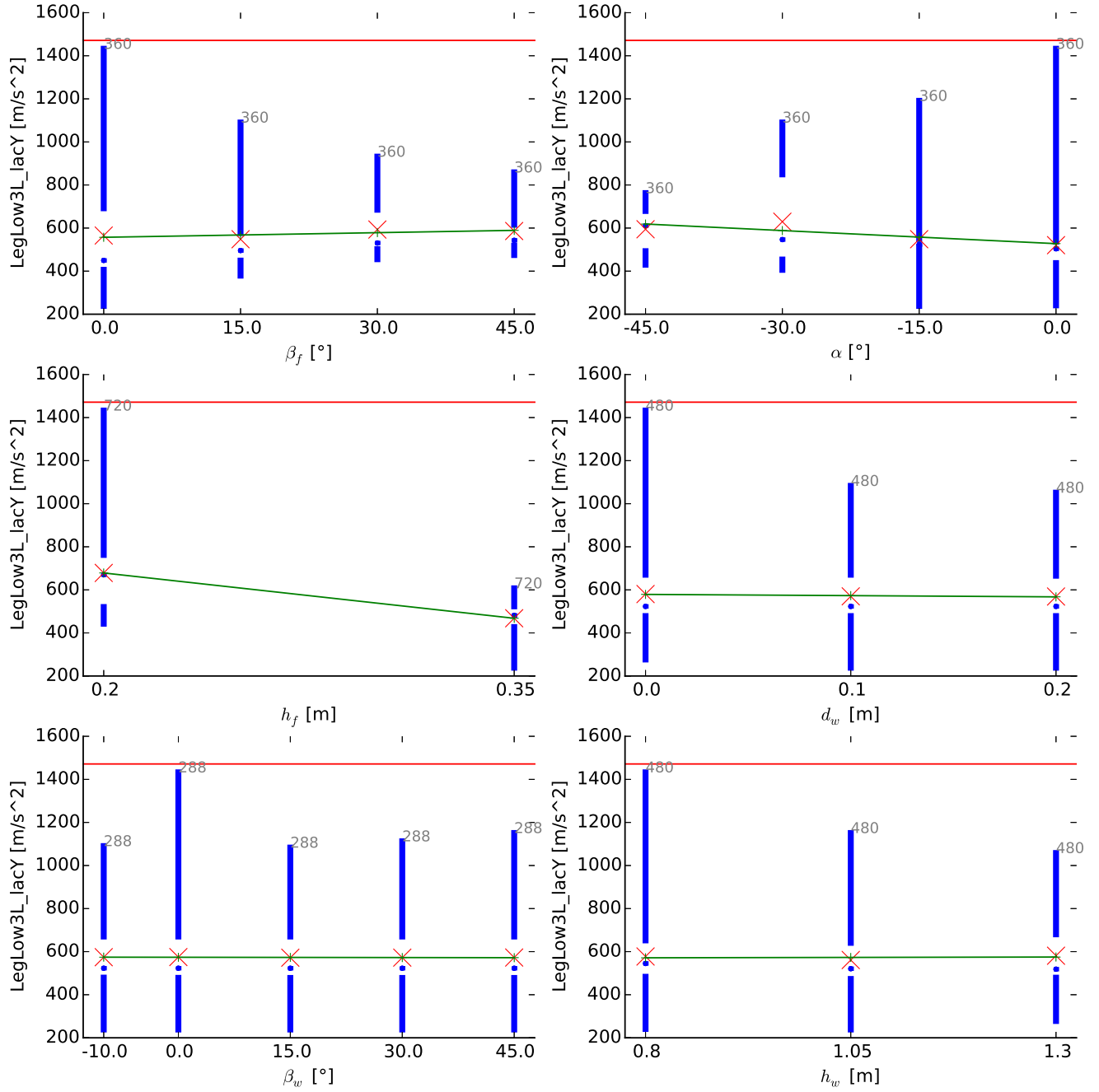


Figure 45: LegLow3L_lacY, F05 pedestrian, 20 km h⁻¹

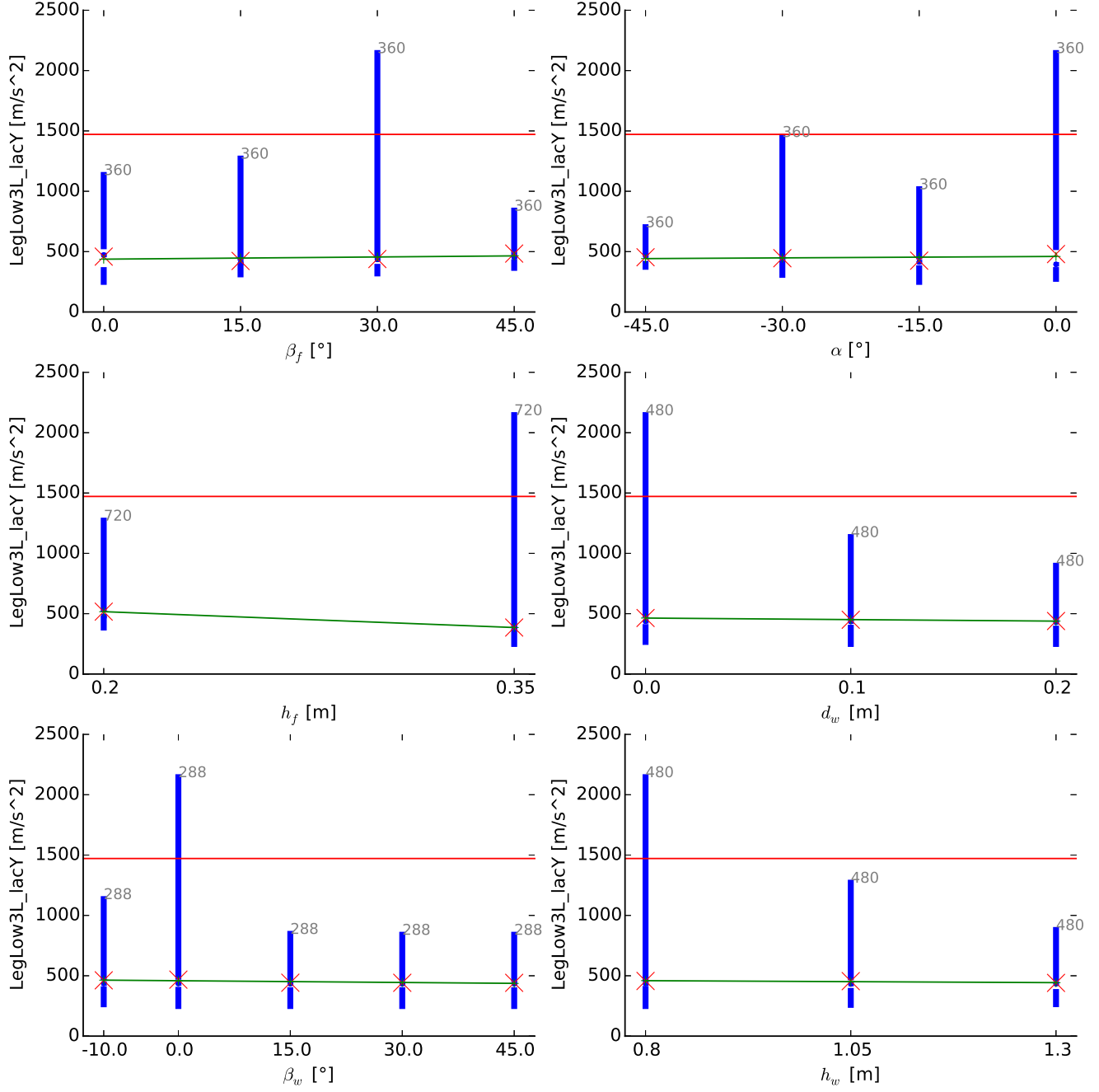


Figure 46: LegLow3L_lacY, M95 pedestrian, 20 km h⁻¹

References

- [1] Edward R. Tufte. *The Visual Display of Quantitative Information*. Graphics Press USA, 2nd edition edition, January 2001.