APPENDIX A

Contrast with Conclusions of Reference 2

A previous analysis reported in Reference 2 dealt with the response of the HC Mk2 to combined collective and longitudinal control inputs initiated at airspeeds of 135 and 150 knots, at climb rates of 0 and 1000 fpm. It was concluded in that analysis that the only set of initial conditions for which the pitchup maneuver could meet the specified response criteria at first impact was the 150 knot airspeed case with 1000 fpm climb rate. The main reason for rejecting all the 135 knot cases was that, by the time the maneuver had progressed to the required 30 deg pitch attitude, the LCT actuators had already retracted well beyond the final positions at which they were found at the accident scene.

The cyclic trim schedules which drove the LCT actuators in that analysis were based on the nominal schedules of the CH-47D, which attain full actuator extension (4.0 deg) at 150+/-10 knots. The lower edge of the tolerance band was used, which at 135 knots placed the actuators at 3.70 deg (fwd) and 3.60 deg (aft). Hence, before the pitchup maneuver even began, the LCT actuators in that simulation were already retracted to their approximate final positions. Even with a first order lag of 0.5 sec and an actuator rate limit of 0.75 deg/sec, the actuators had to retract significantly farther as airspeed fell toward 120 knots or less, and they therefore failed to meet the LCT actuator extension criteria.

In the present analysis, the cyclic trim schedules are based on the HC Mk2 schedules per Reference 3, which attain full extension at 141+/-9 knots. Using the lower edge of the tolerance band as before, both LCT actuators are at full extension (4.0 deg) at 135 knots, and on a static basis would not be at their final accident positions until a 6 to 8 knot airspeed loss had occurred. Factoring in the effects of the 0.5 sec lag and the 0.75 deg/sec actuator rate limits, airspeed could fall to 120 knots or less in the pitchup maneuver before the LCT actuators would attain their final positions as found at the accident scene.

Hence, if the appropriate version of the HC Mk2 LCT schedules had been used in the previous study reported in Reference 2, many of the rejected cases at 135 knot initial conditions would have been retained as valid cases potentially representing the final pitchup maneuver of ZD576, and it would not have been concluded at that time that only the 150 knot cases with 1000 fpm climb rate could meet the specified response criteria.

APPENDIX B

Simulation Records from Table 2

This Appendix contains the simulation records for the 13 cases in Table 2 which simultaneously meet the 30 deg pitch attitude and 20 deg climb angle criteria within +/-5 deg. The trim initial conditions prior to the control inputs are listed below:

Gross Weight	37700 lb	True Airspeed	135 kt
Center of Gravity	Sta 325 in.	Ground Speed	160 kt
Density Altitude	420 ft	Rate of Climb	1000 fpm

These cases were retained for further study, to determine whether they meet the Additional Maneuver Criteria relating to LCT and DASH actuator extensions, maximum altitude gain, maximum engine torque, and minimum rotor speed.

The case numbers and associated control inputs and intersection data are tabulated below.

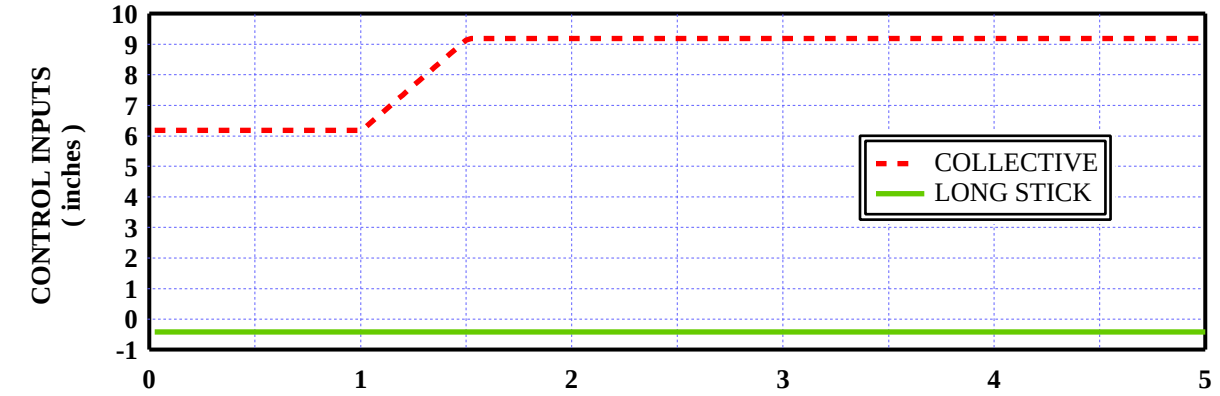
Case Number	Coll. Input	Long. Input	Intersection Angle / Time (deg) / (sec)
A-30	3.00	0.00	26 / 5.1
50-1K	2.75	0.25	26 / 4.6
A-28	2.50	0.50	27 / 4.7
47-1K	2.25	0.75	27 / 4.5
A-20	2.00	1.00	28 / 4.5
43-1K	1.75	1.25	26 / 4.0
40-1K	1.50	1.25	31 / 5.1
A-07	1.50	1.50	26 / 3.8
38-1K	1.25	1.50	30 / 4.5
36-1K	1.00	1.75	26 / 3.8
35-1K	0.75	1.75	34 / 5.1
A-24	0.50	2.00	26 / 3.7
32-1K	0.25	2.00	30 / 4.5

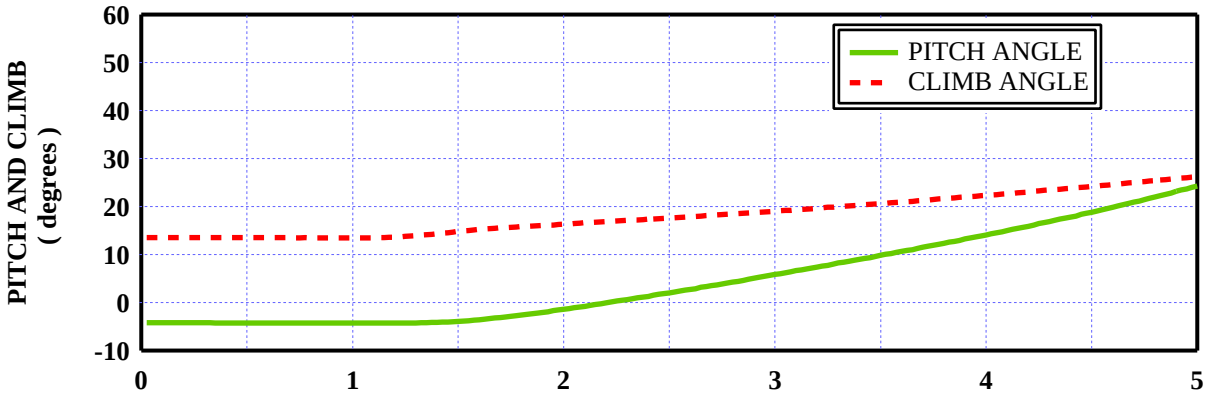
HC MK II SIMULATED CONTROL RESPONSE

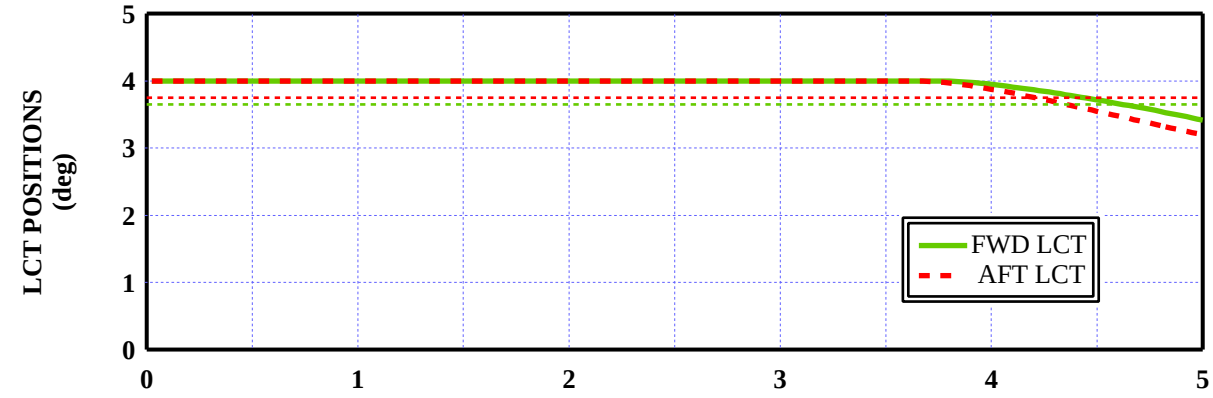
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

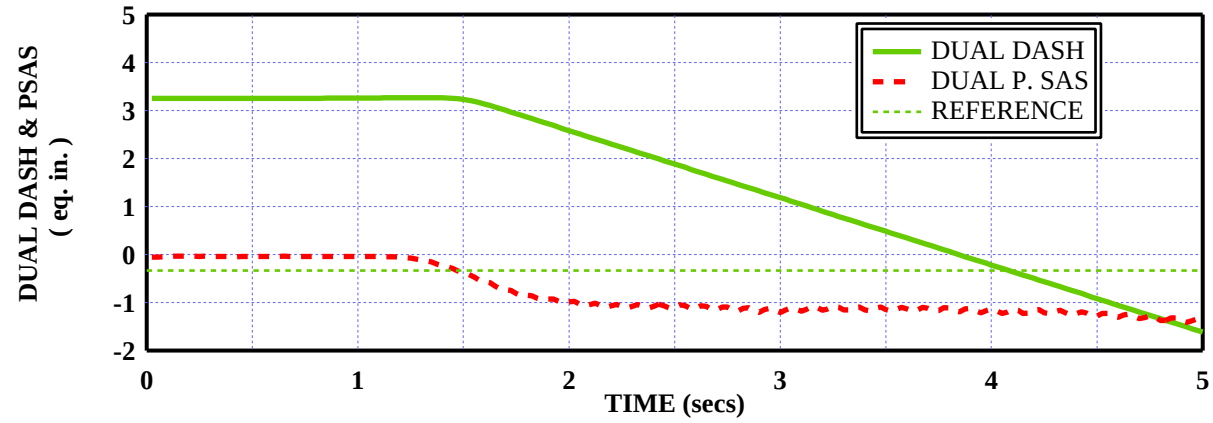
CASE A 30

CYCLIC TRIM: ADVANCED







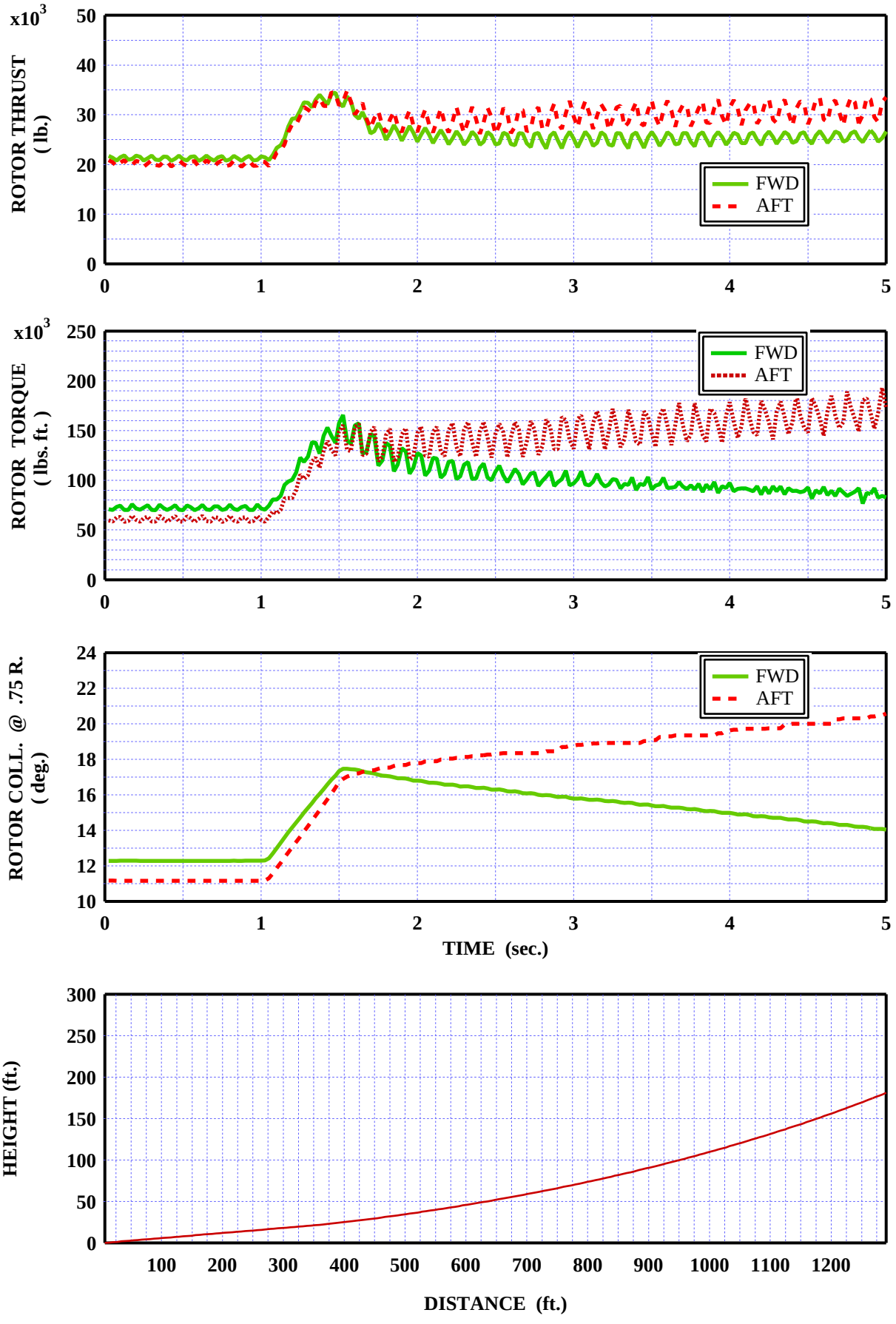


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 30

CYCLIC TRIM: ADVANCED

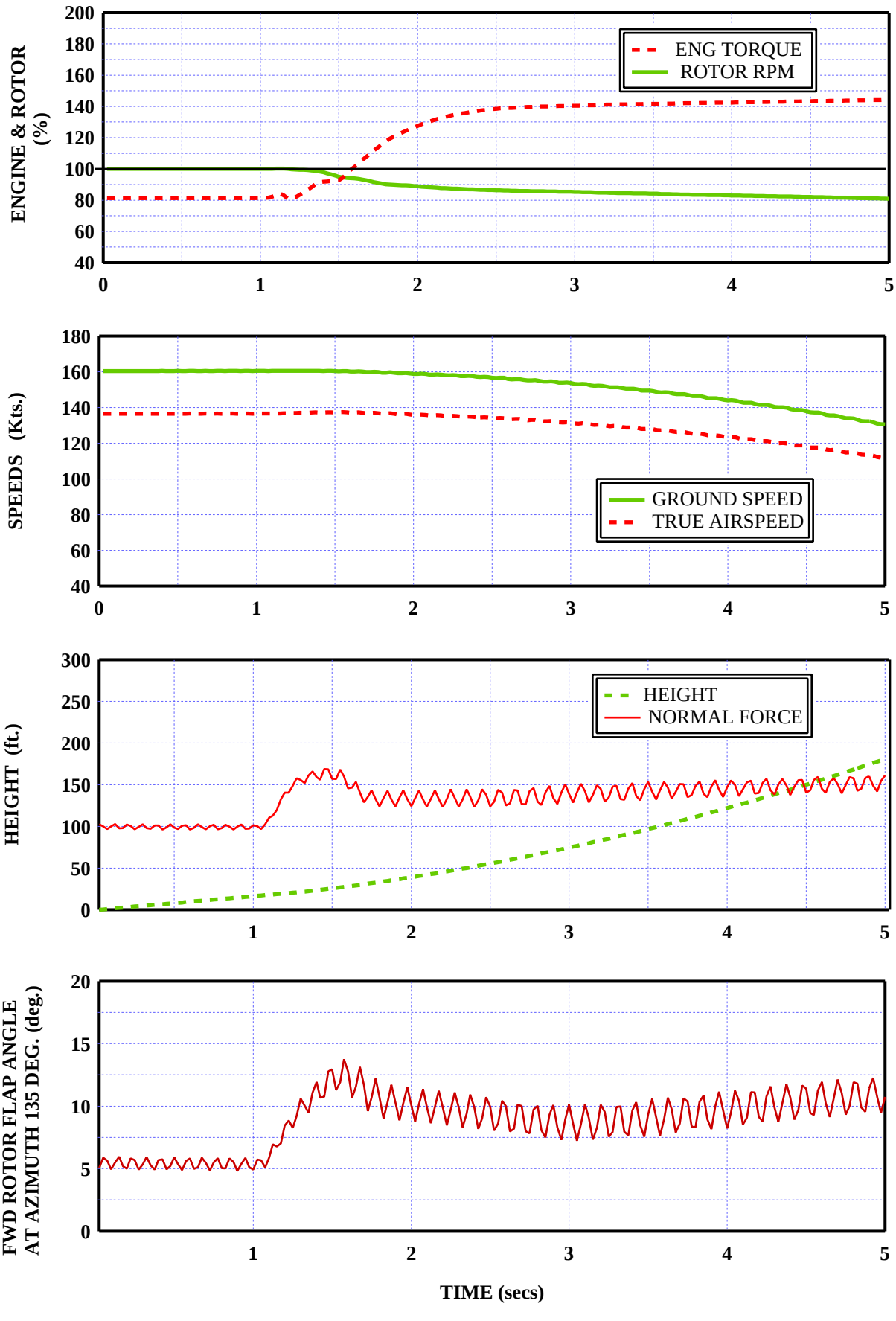


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 30

CYCLIC TRIM: ADVANCED

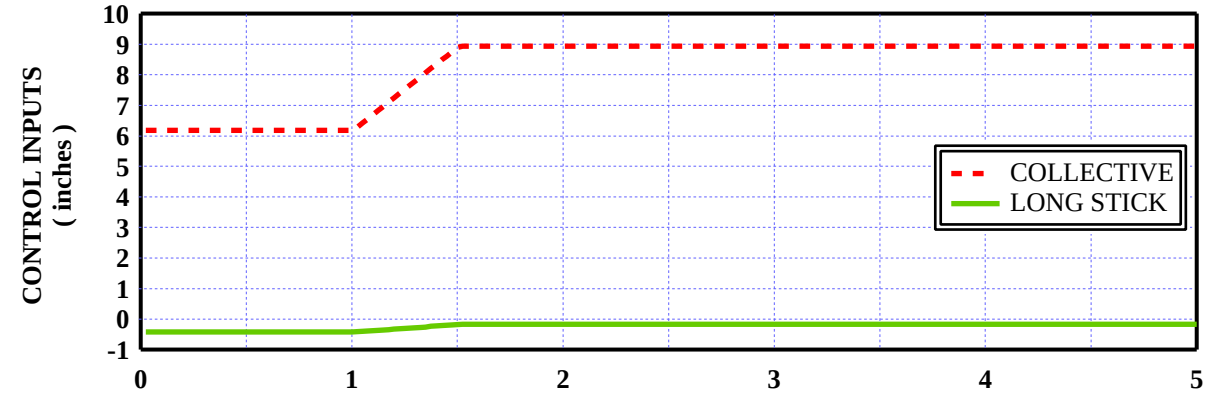


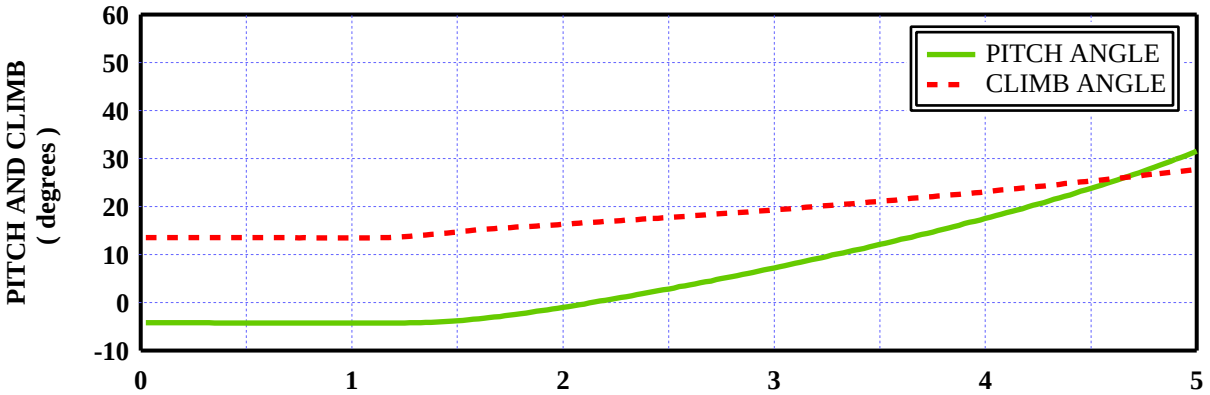
HC MK II SIMULATED CONTROL RESPONSE

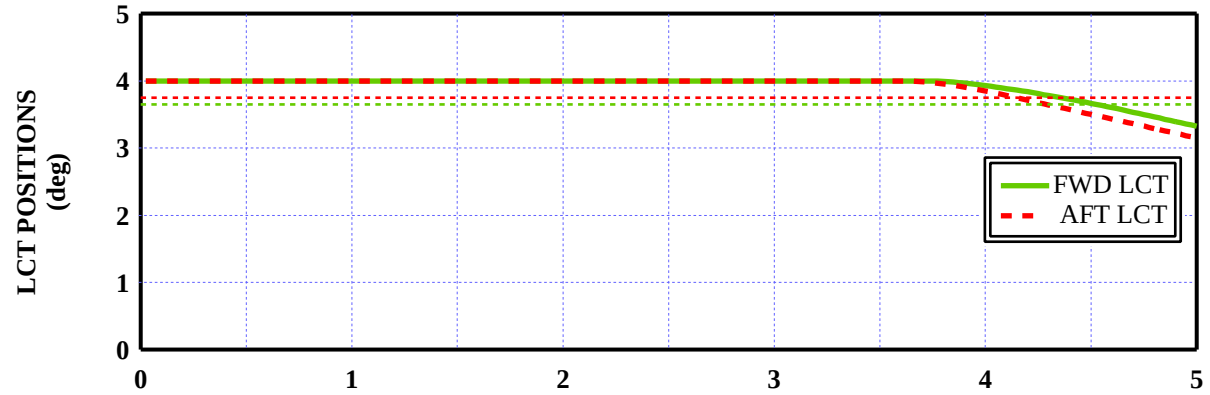
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

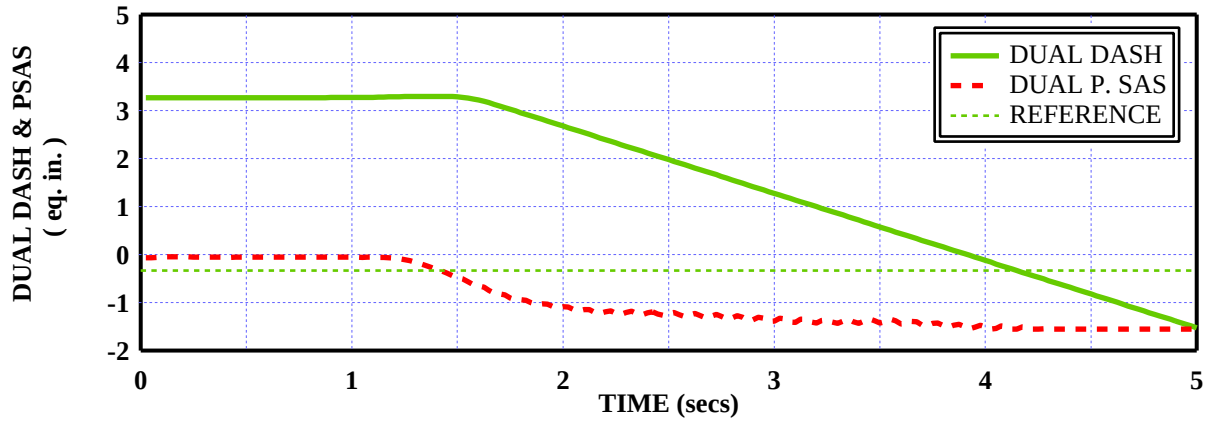
CASE 50 _1K

CYCLIC TRIM: ADVANCED







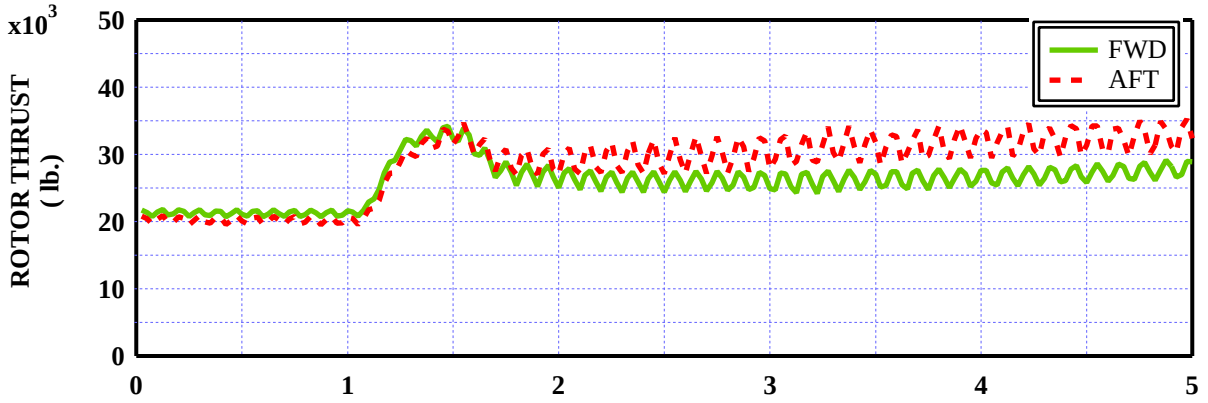


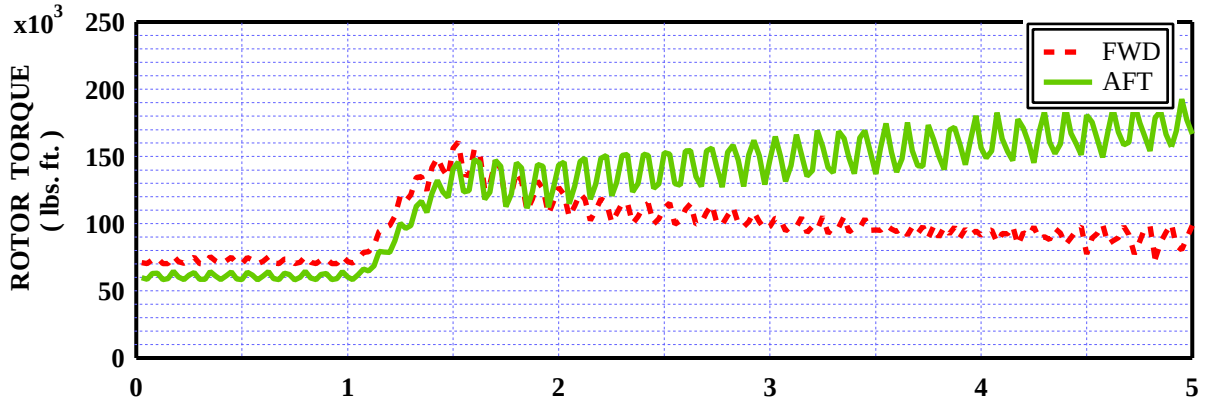
HC MK II SIMULATED CONTROL RESPONSE

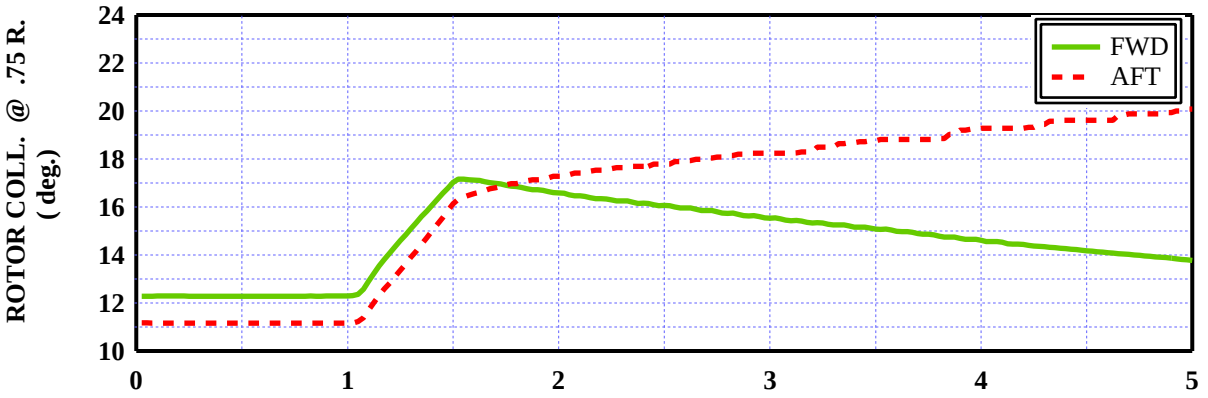
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

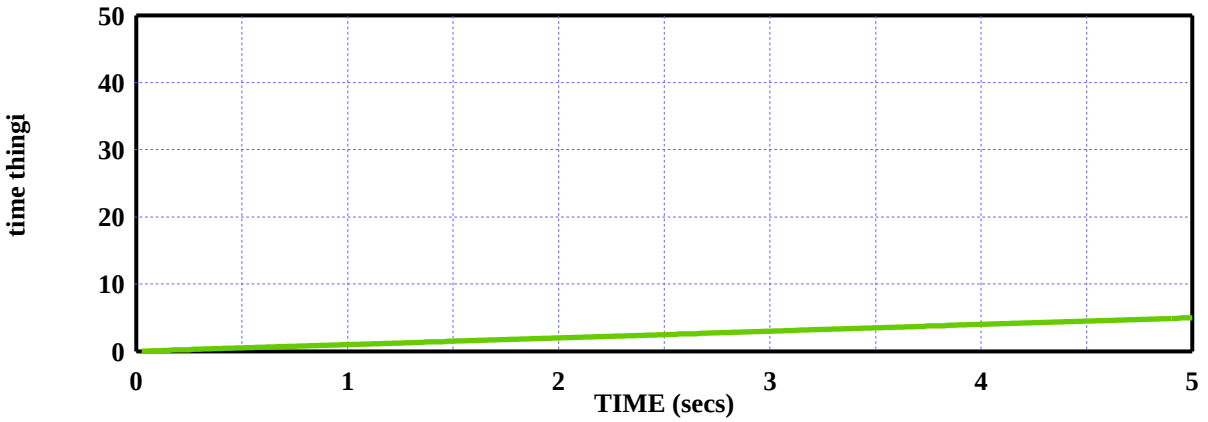
CASE 50_1K

CYCLIC TRIM: ADVANCED







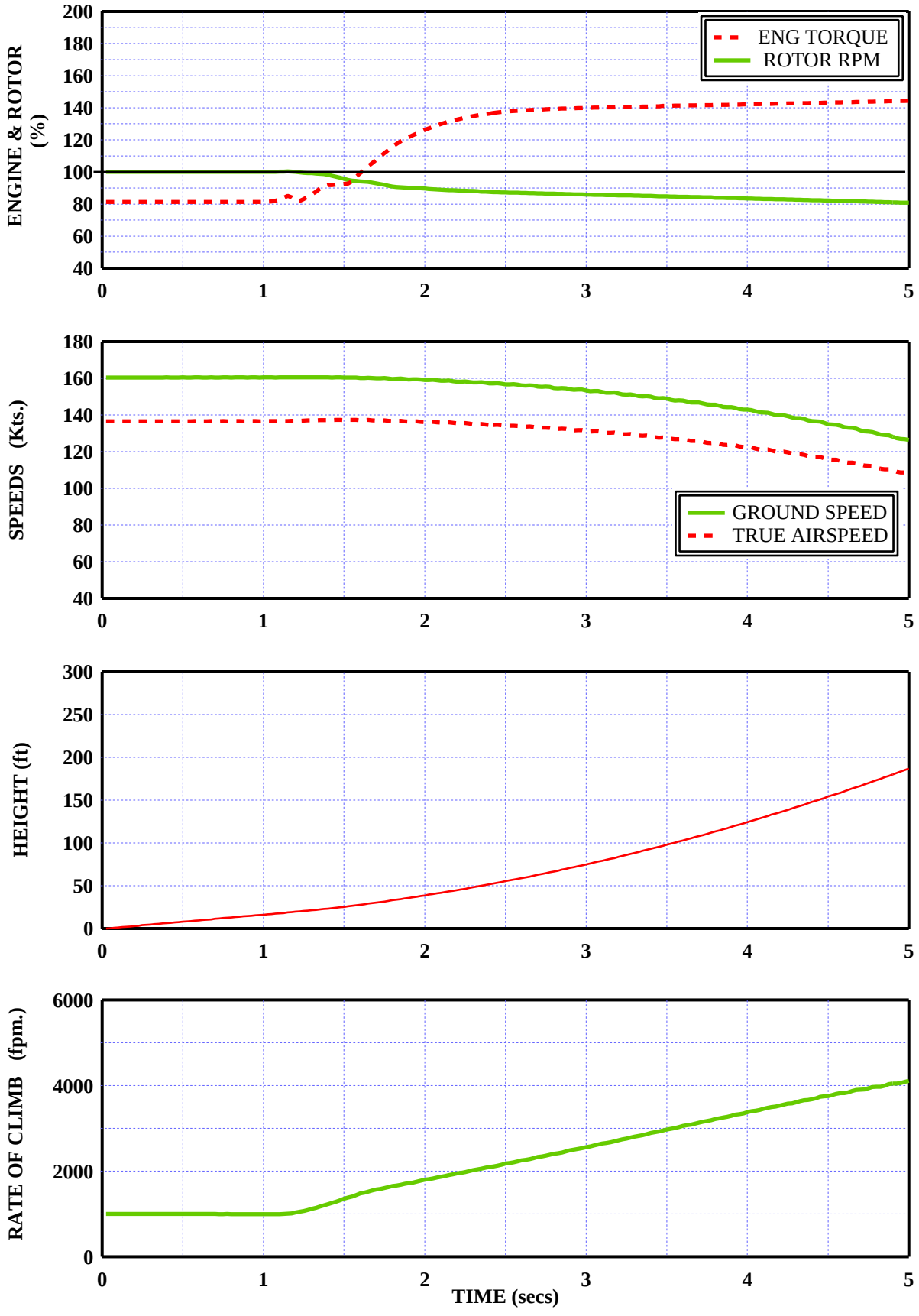


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 50_1K

CYCLIC TRIM: ADVANCED

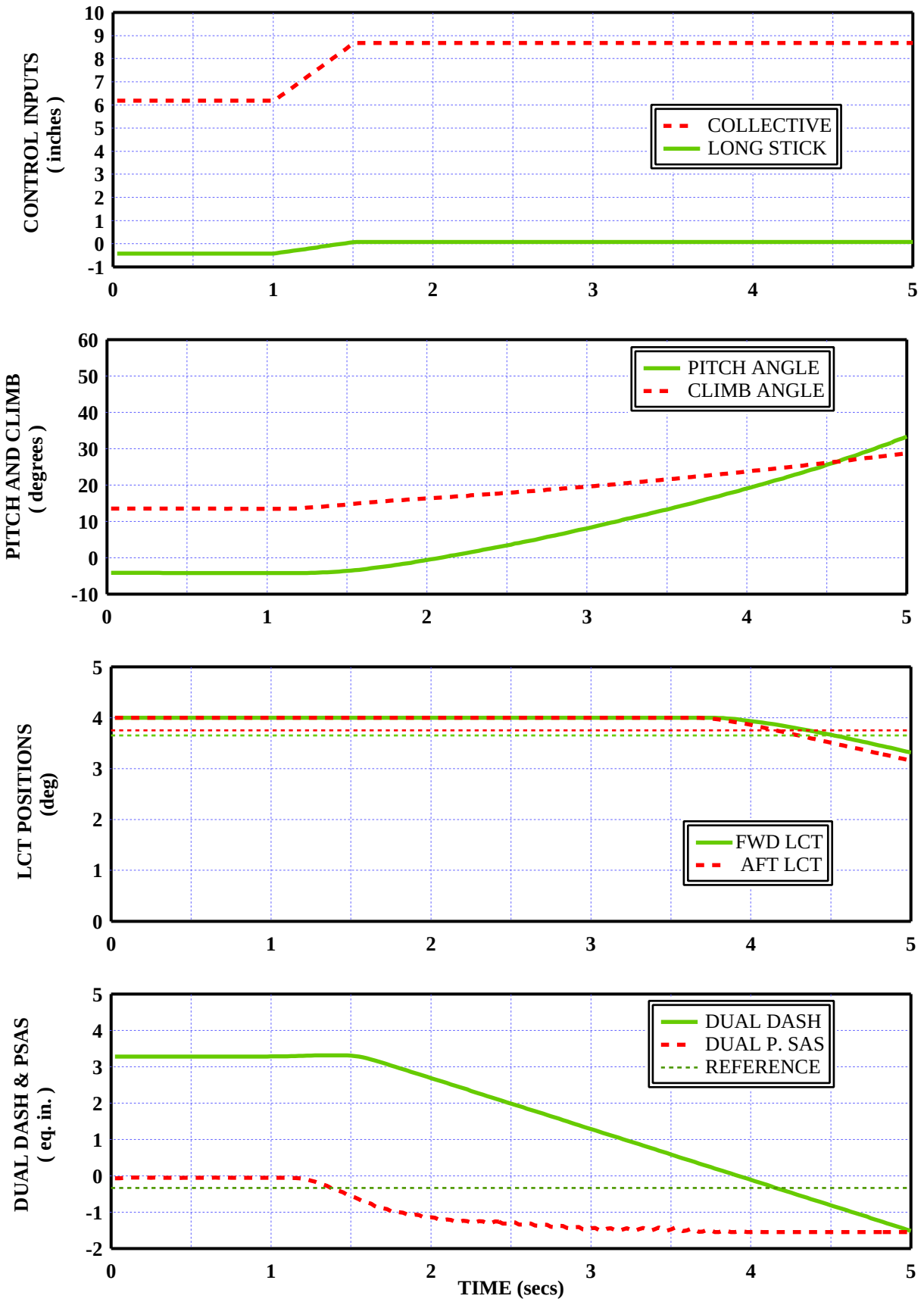


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 28

CYCLIC TRIM: ADVANCED

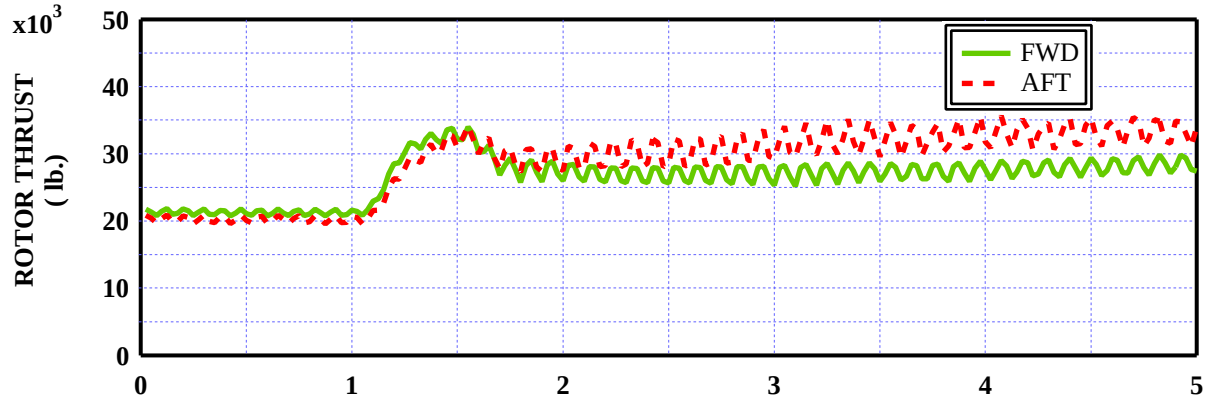


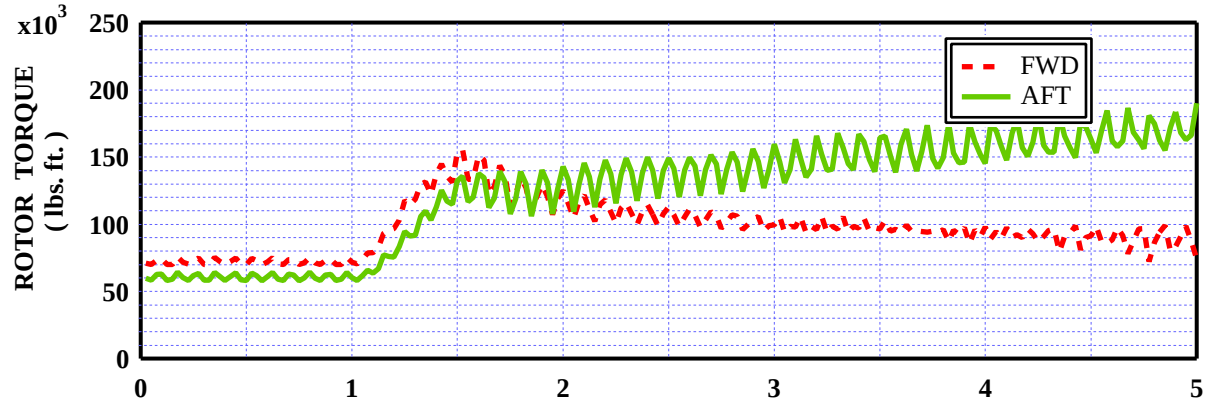
HC MK II SIMULATED CONTROL RESPONSE

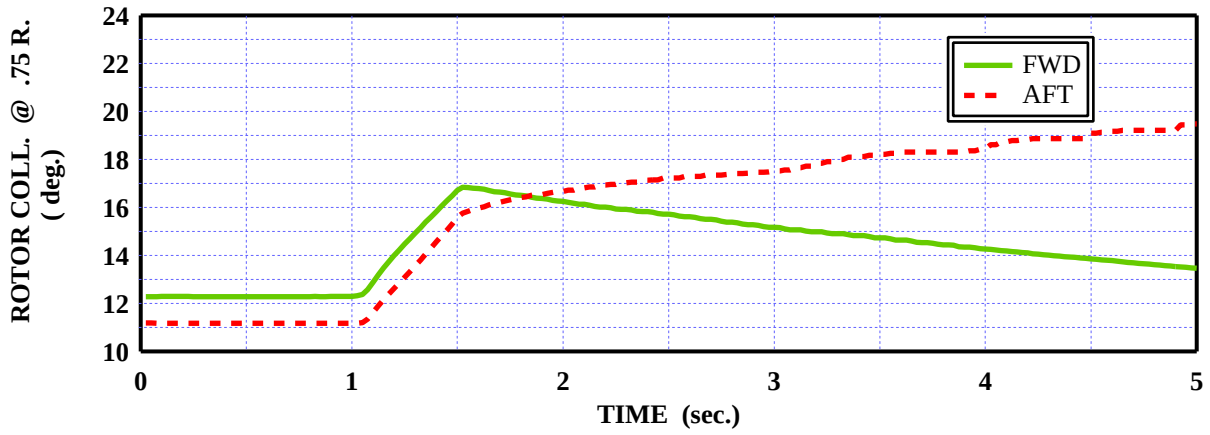
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

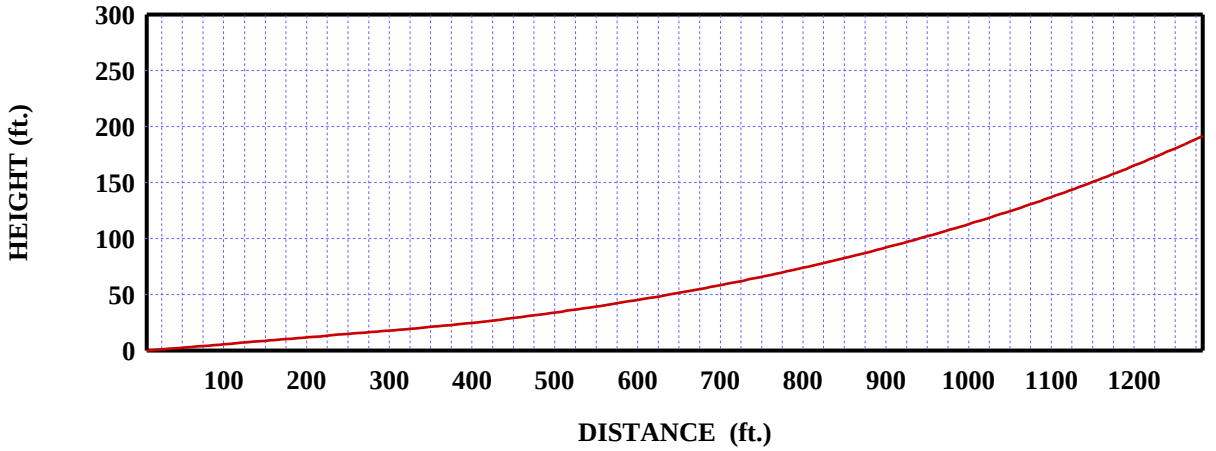
CASE A 28

CYCLIC TRIM: ADVANCED







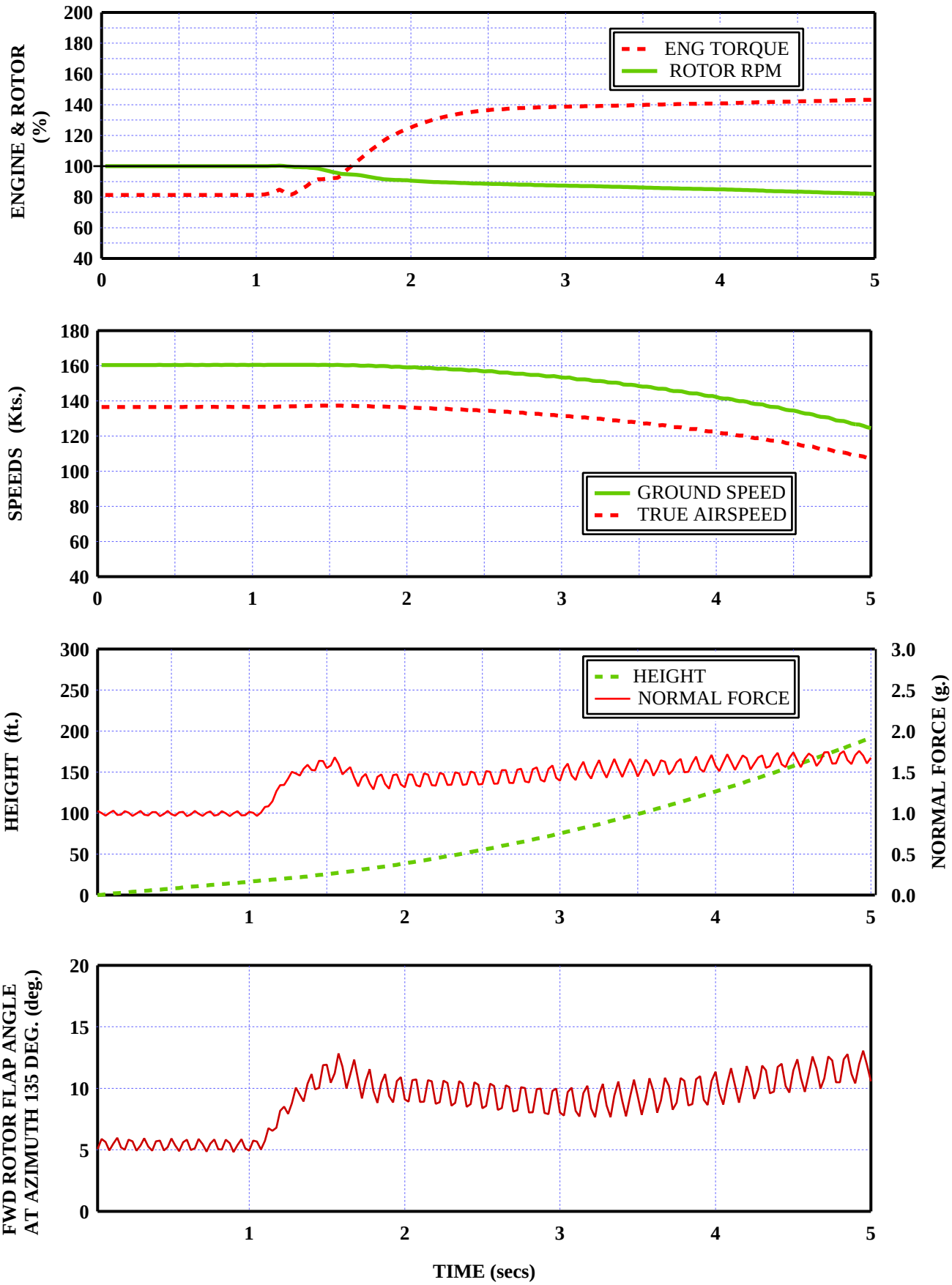


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 28

CYCLIC TRIM: ADVANCED

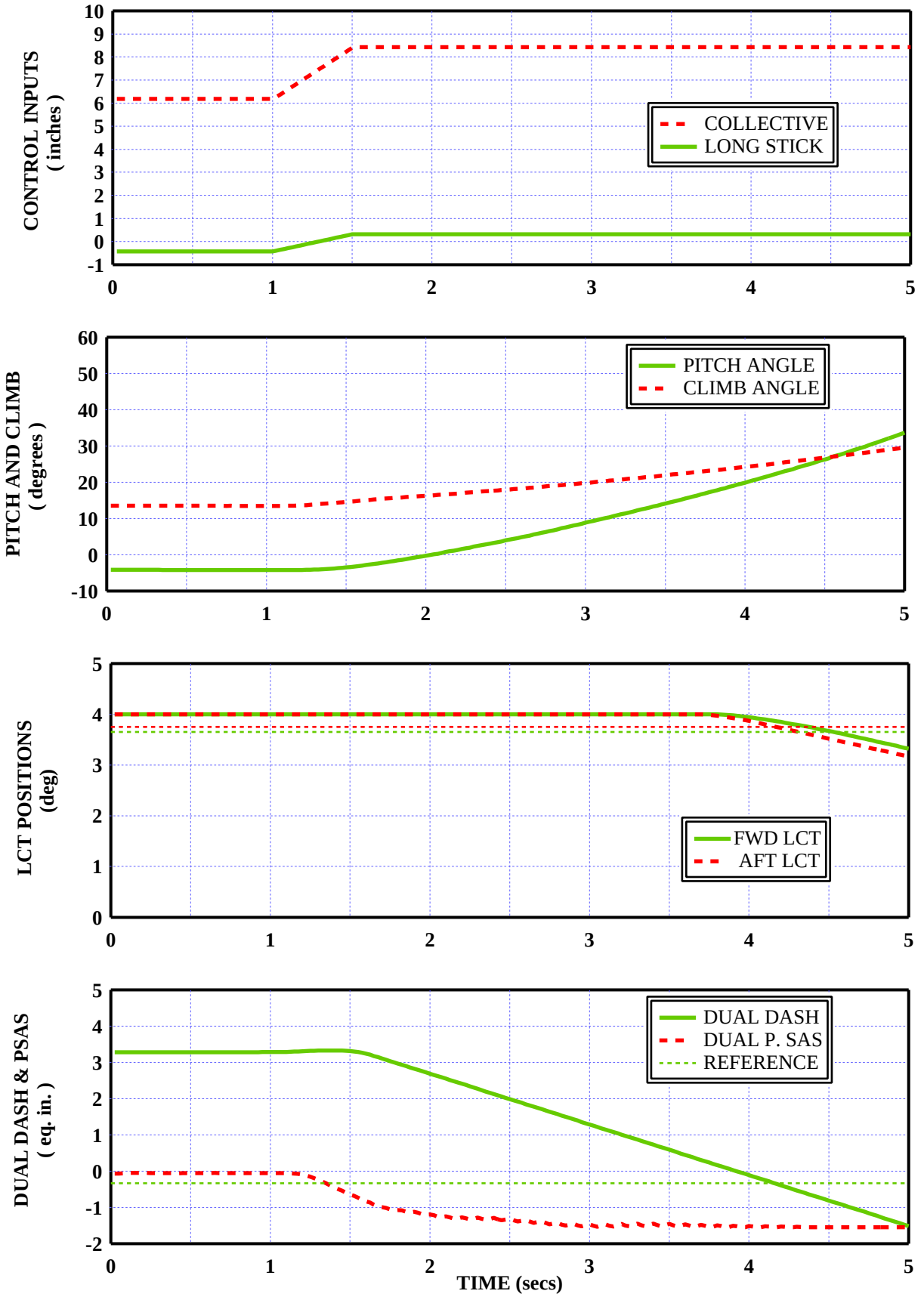


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 47 - 1K

CYCLIC TRIM: ADVANCED

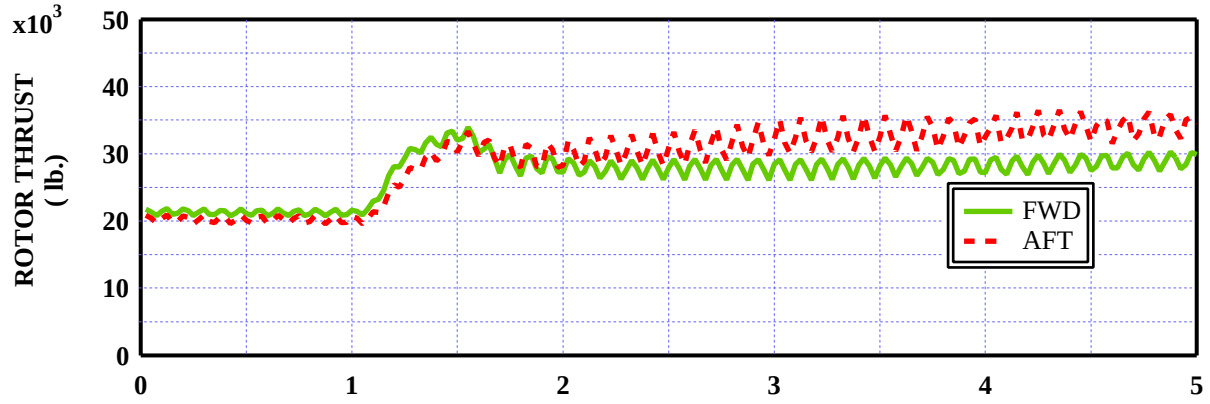


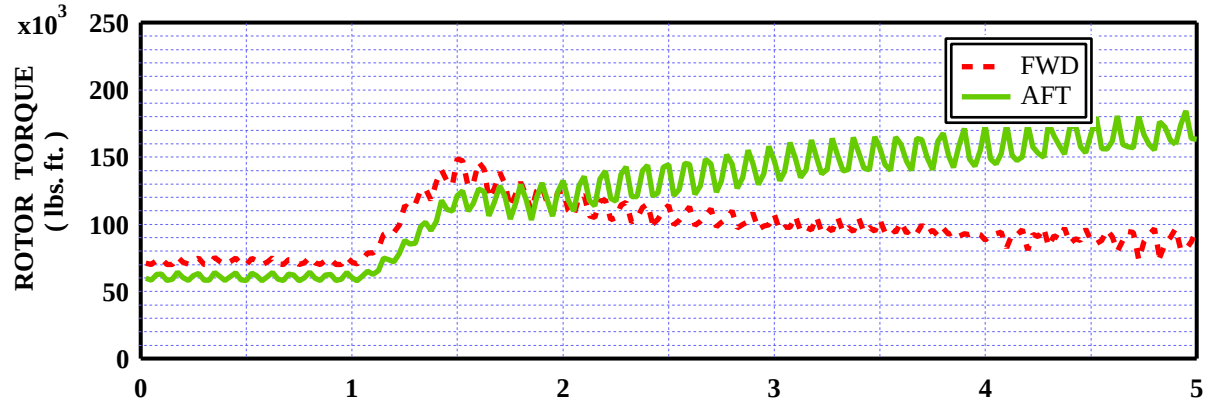
HC MK II SIMULATED CONTROL RESPONSE

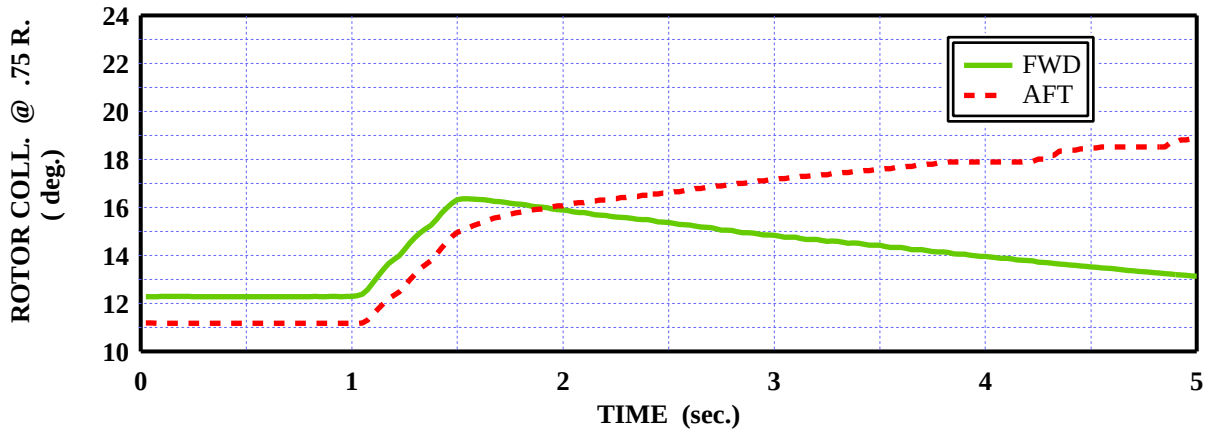
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

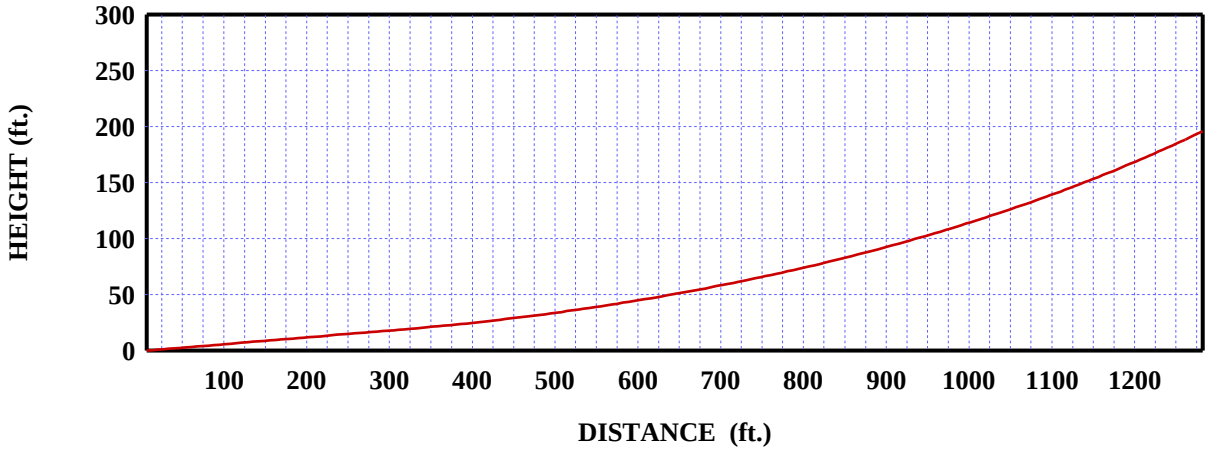
CASE 47 - 1K

CYCLIC TRIM: ADVANCED







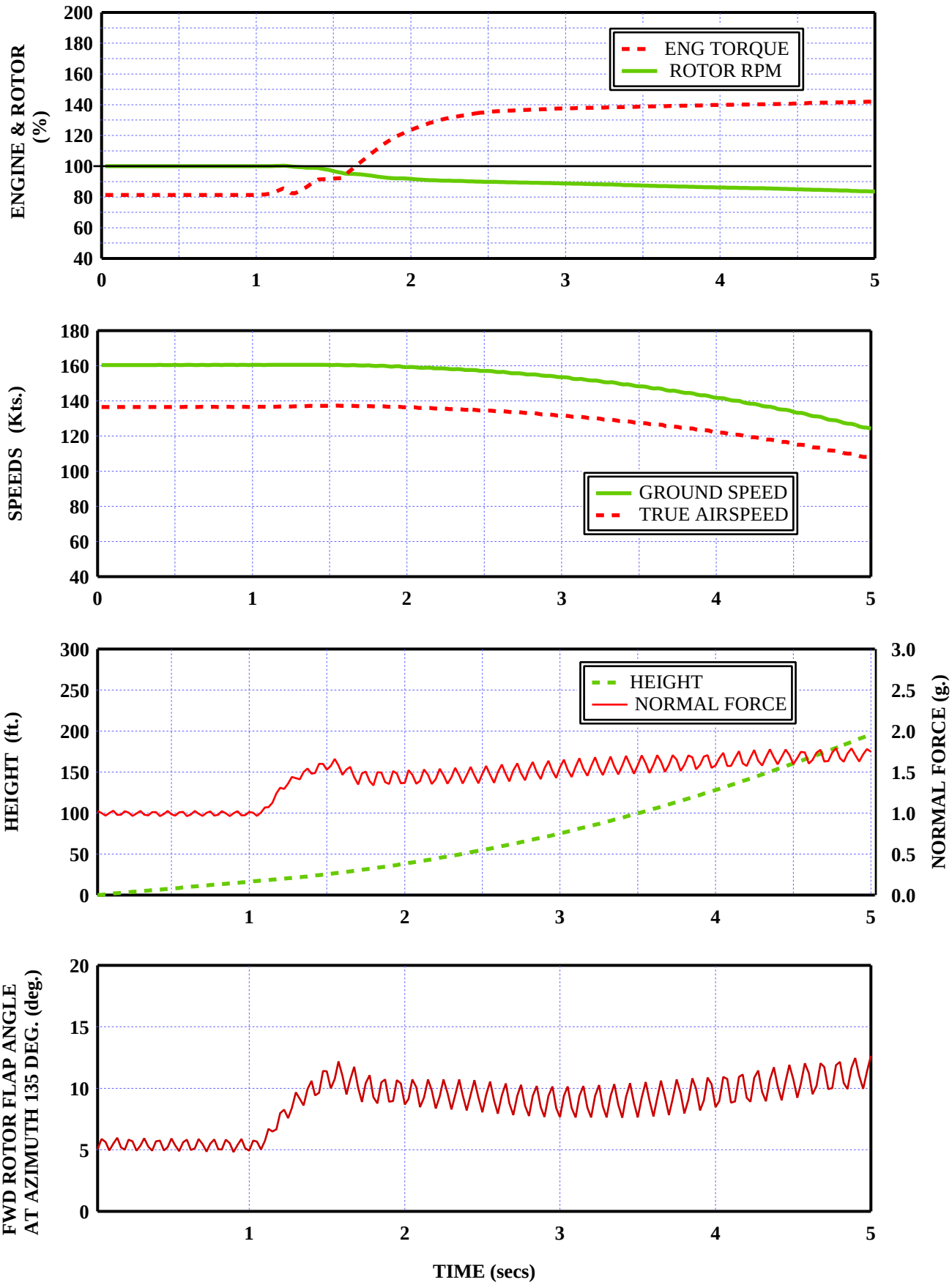


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 47 - 1K

CYCLIC TRIM: ADVANCED

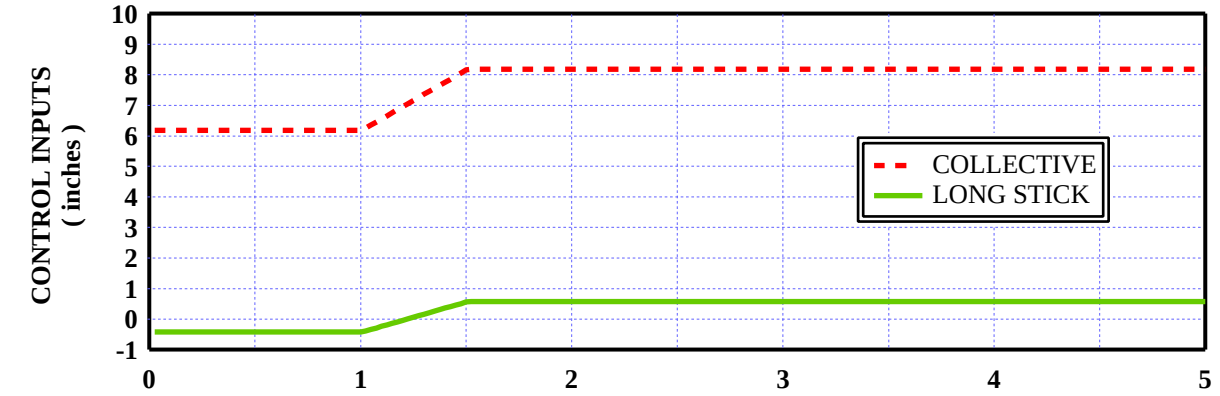


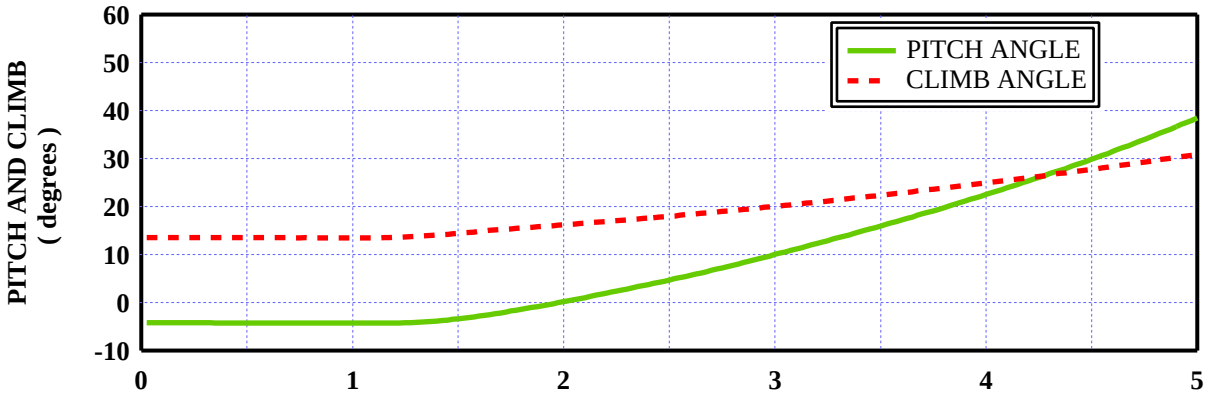
HC MK II SIMULATED CONTROL RESPONSE

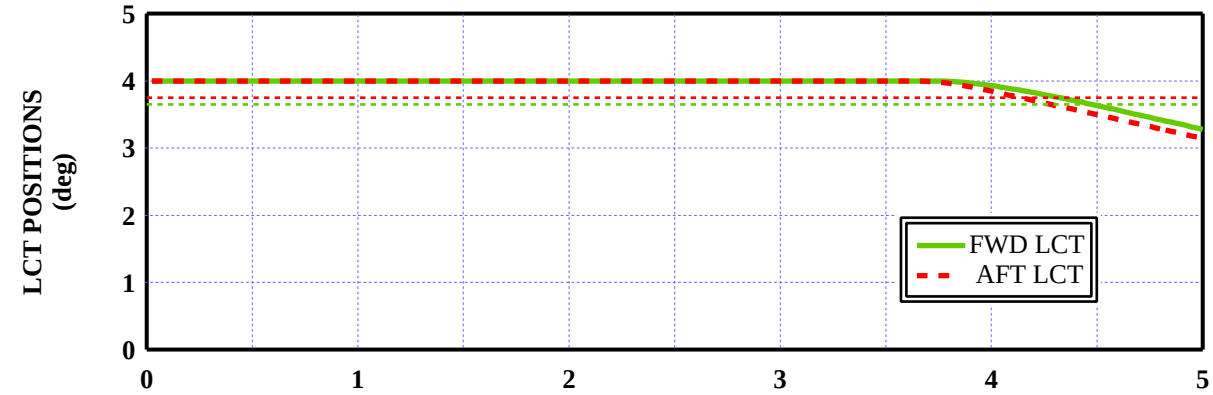
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

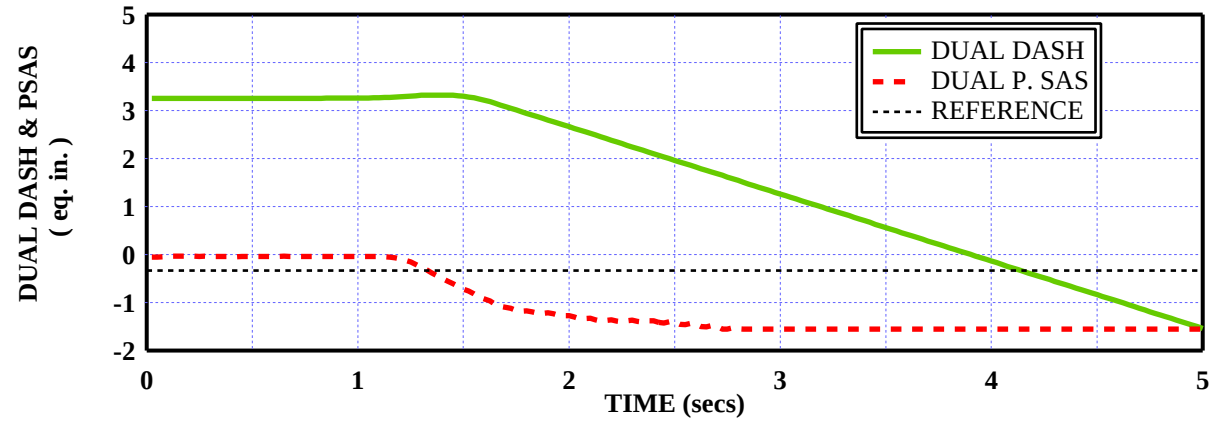
CASE A 20

CYCLIC TRIM: ADVANCED







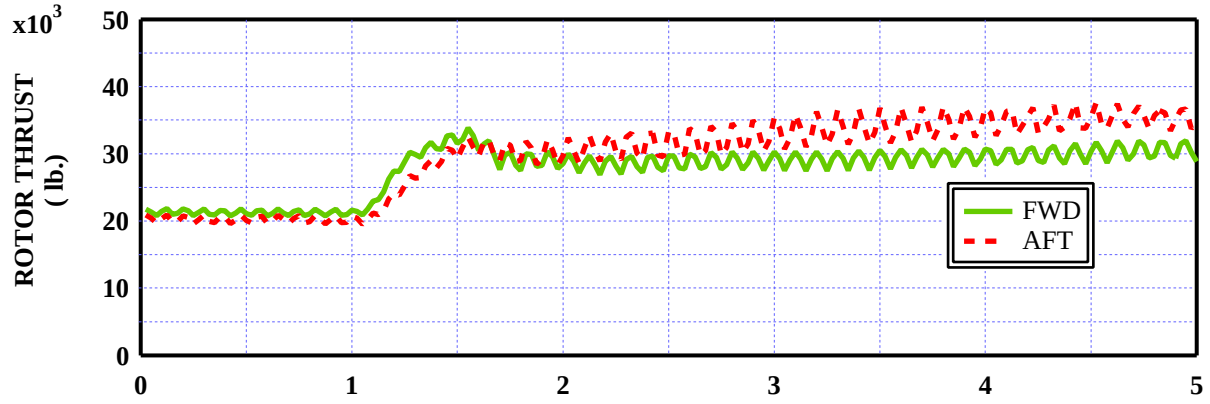


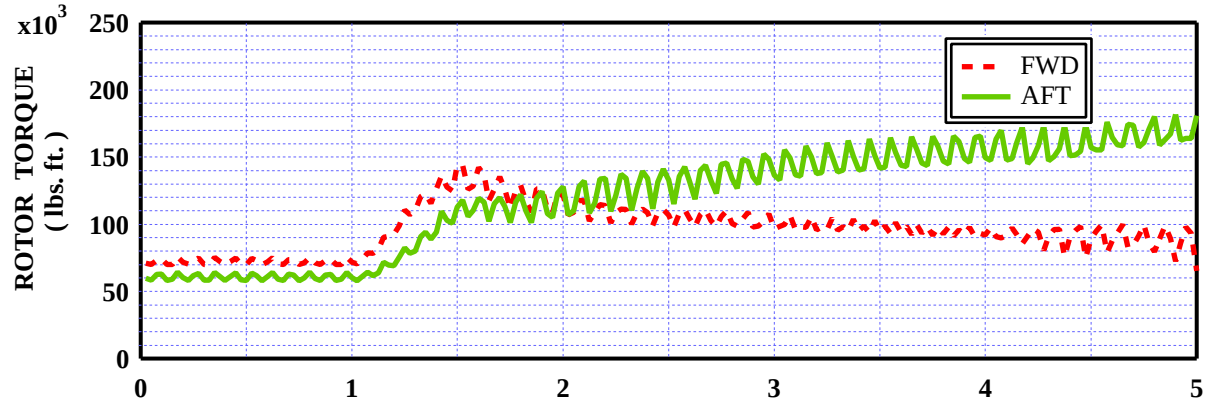
HC MK II SIMULATED CONTROL RESPONSE

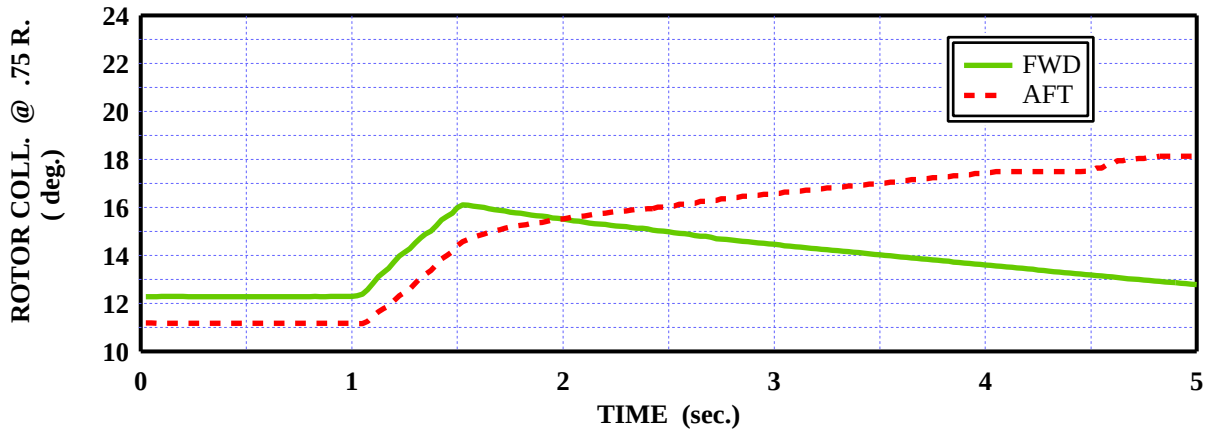
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

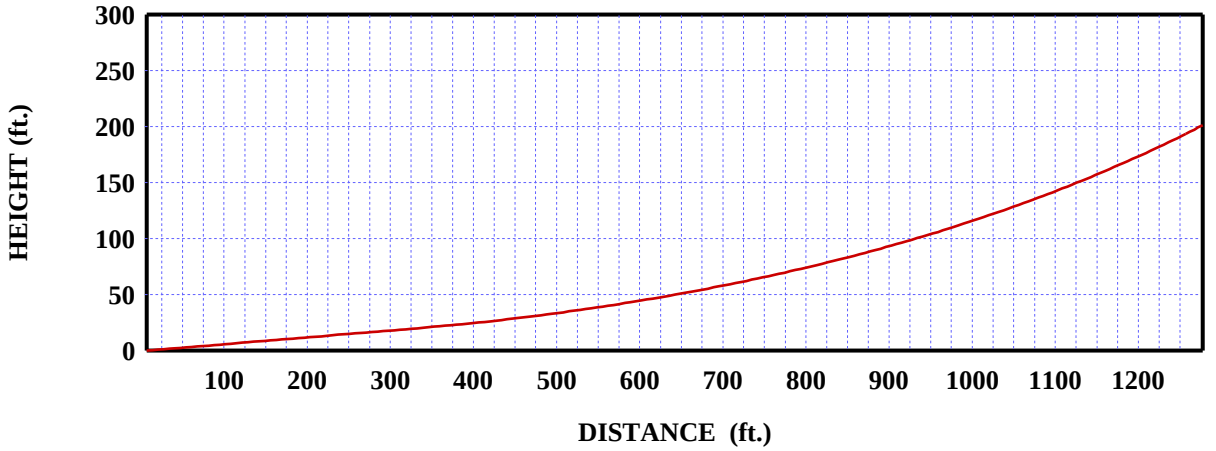
CASE A 20

CYCLIC TRIM: ADVANCED







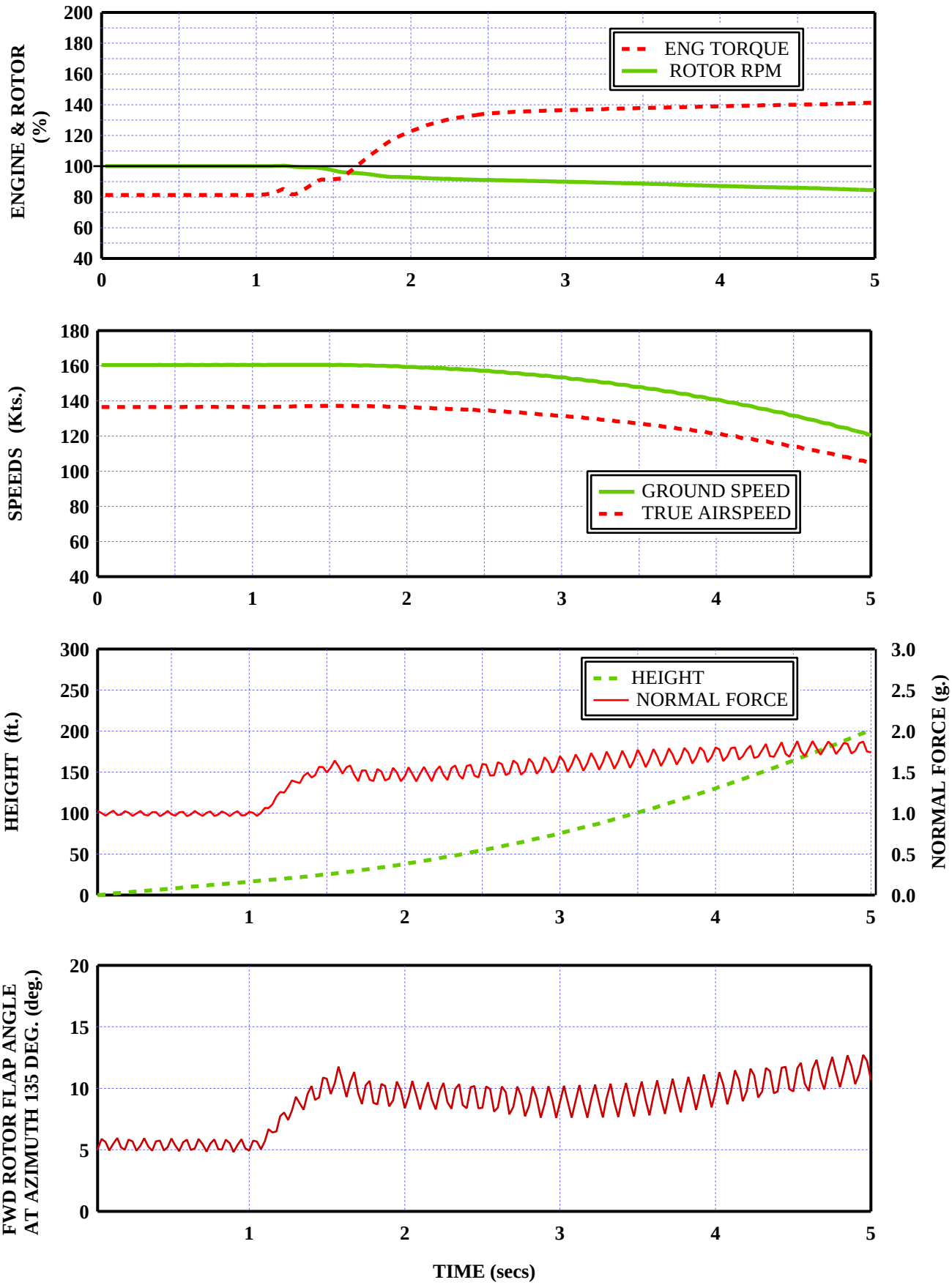


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 20

CYCLIC TRIM: ADVANCED

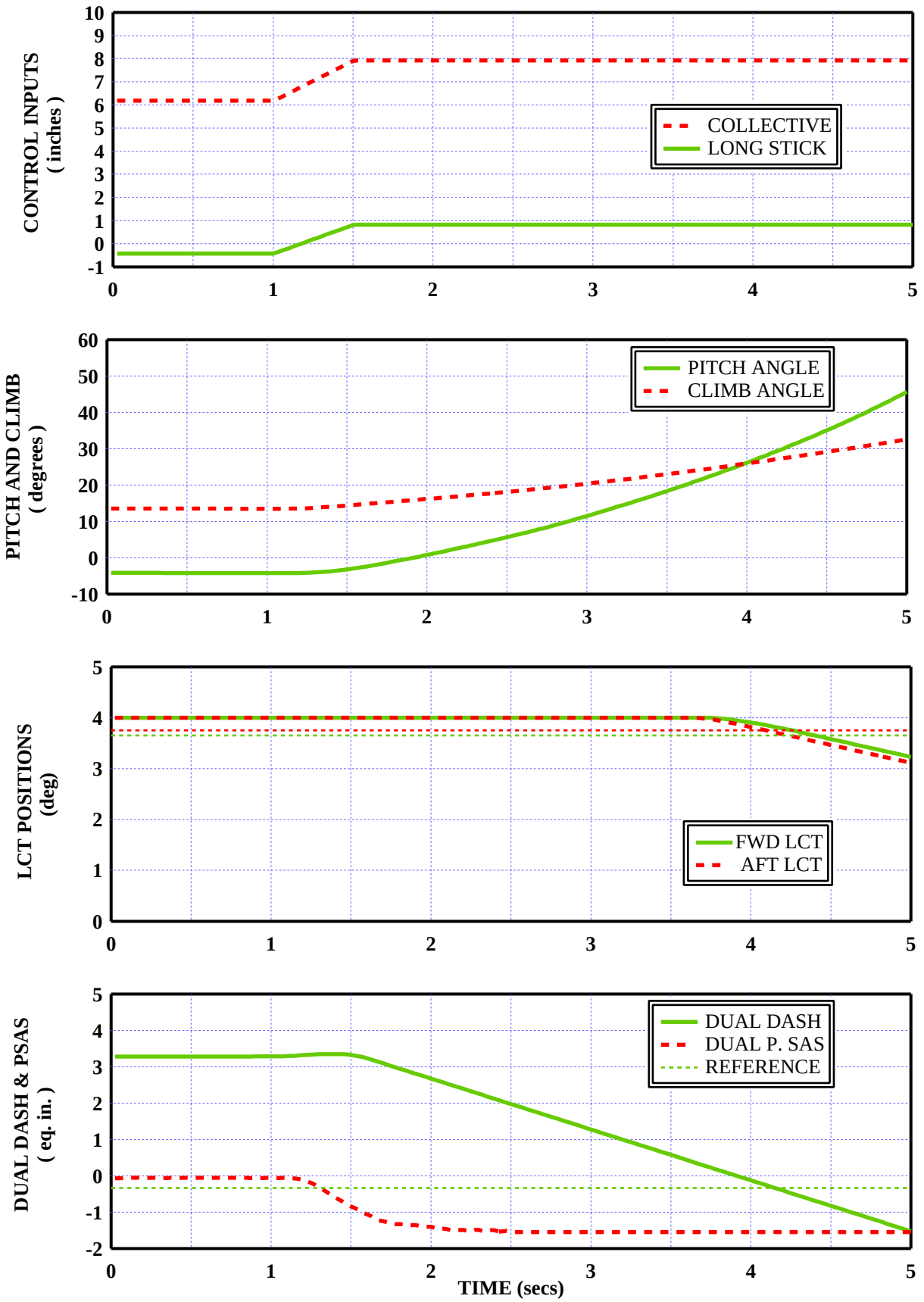


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 43 - 1K

CYCLIC TRIM: ADVANCED

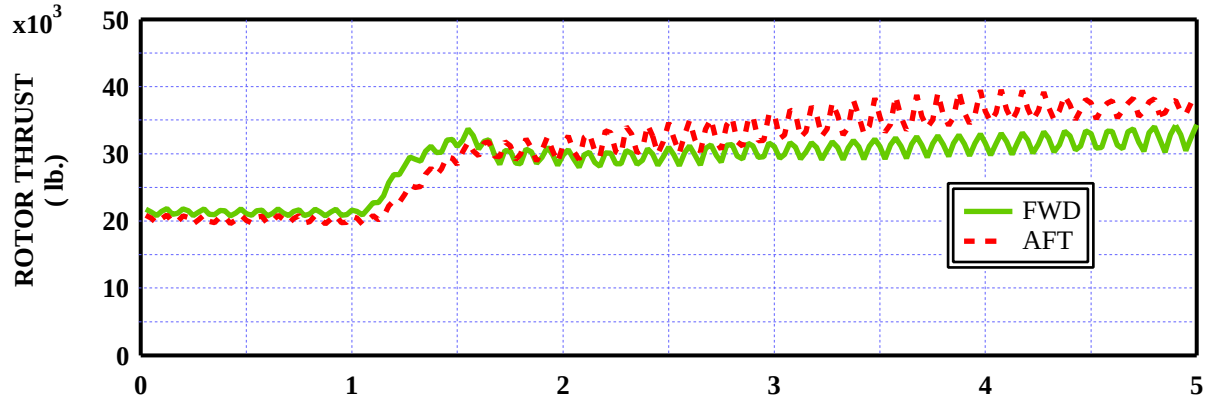


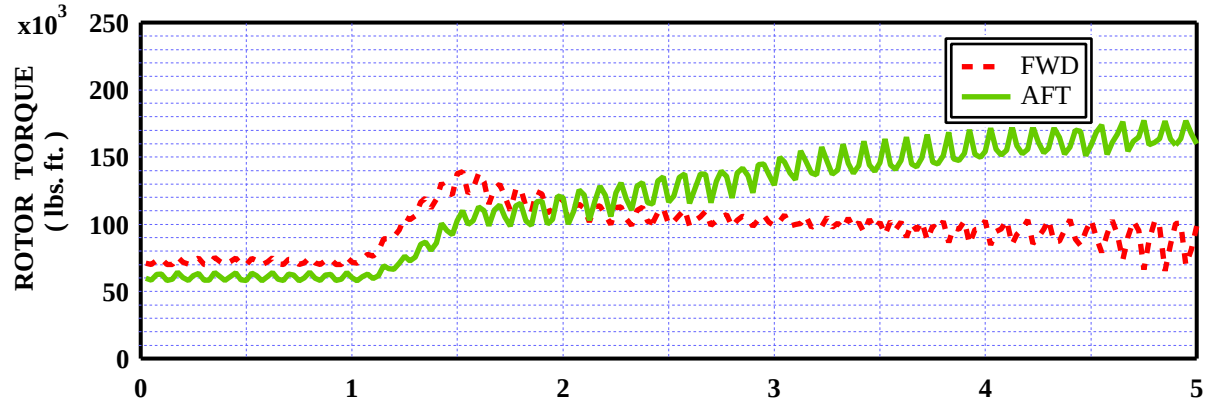
HC MK II SIMULATED CONTROL RESPONSE

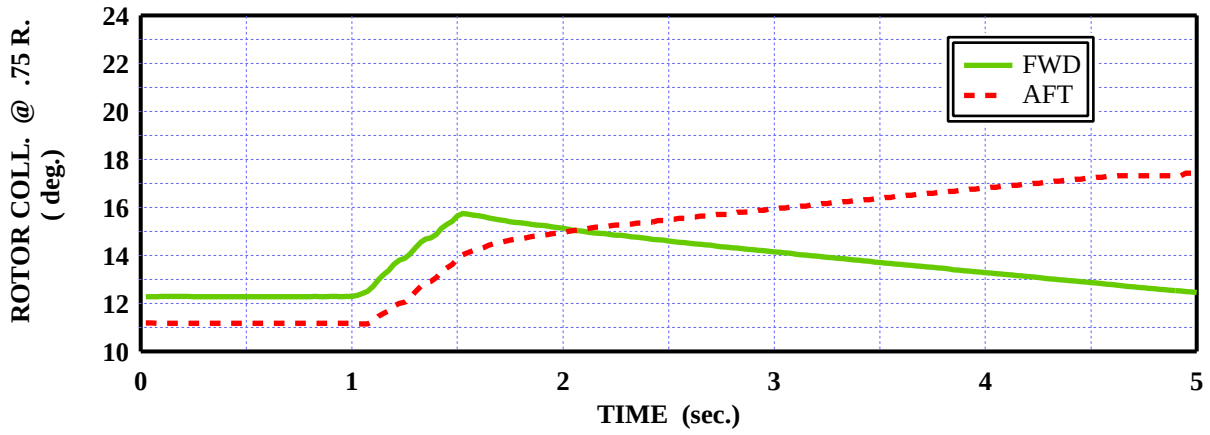
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

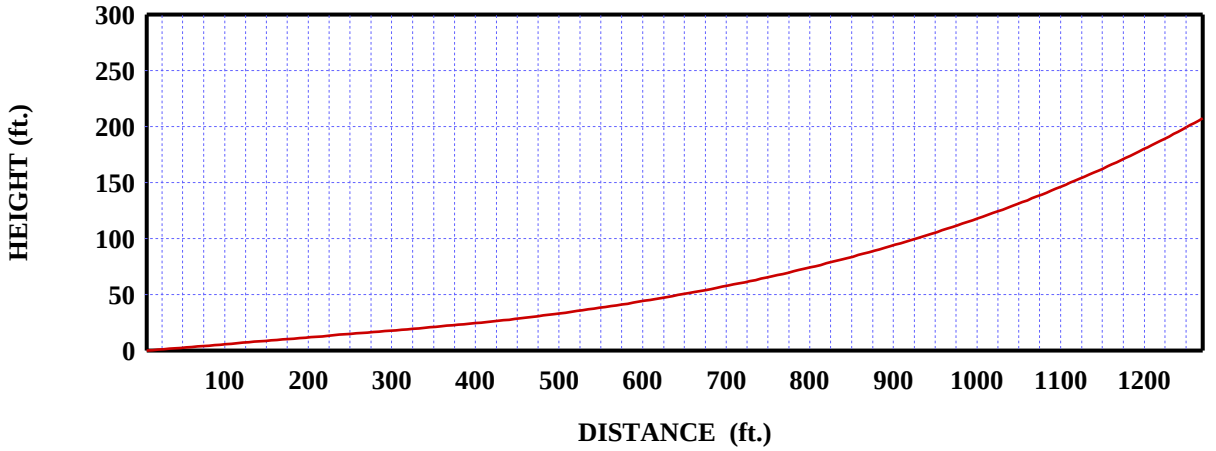
CASE 43 - 1K

CYCLIC TRIM: ADVANCED







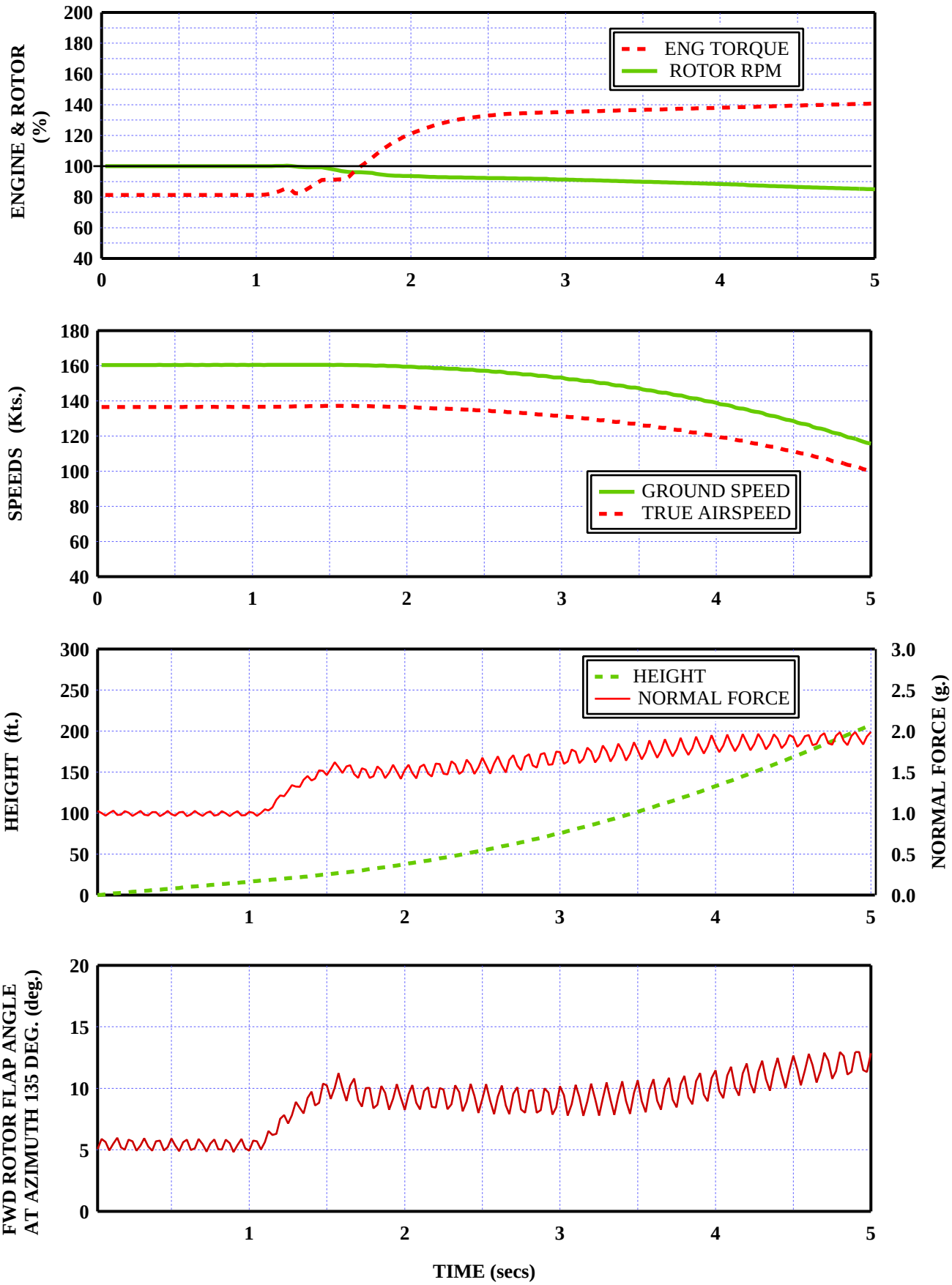


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 43 - 1K

CYCLIC TRIM: ADVANCED

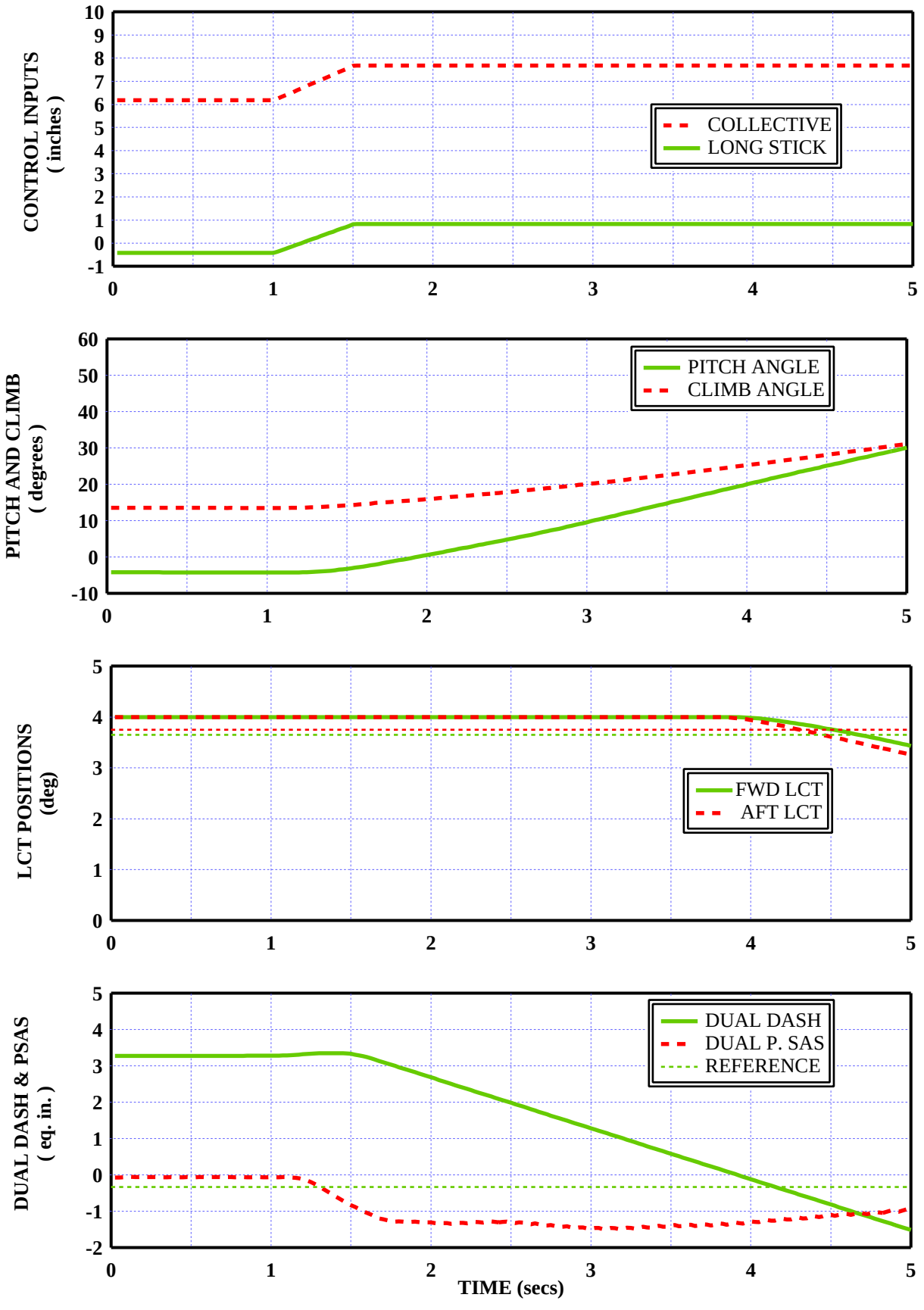


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 40 - 1 K

CYCLIC TRIM: ADVANCED

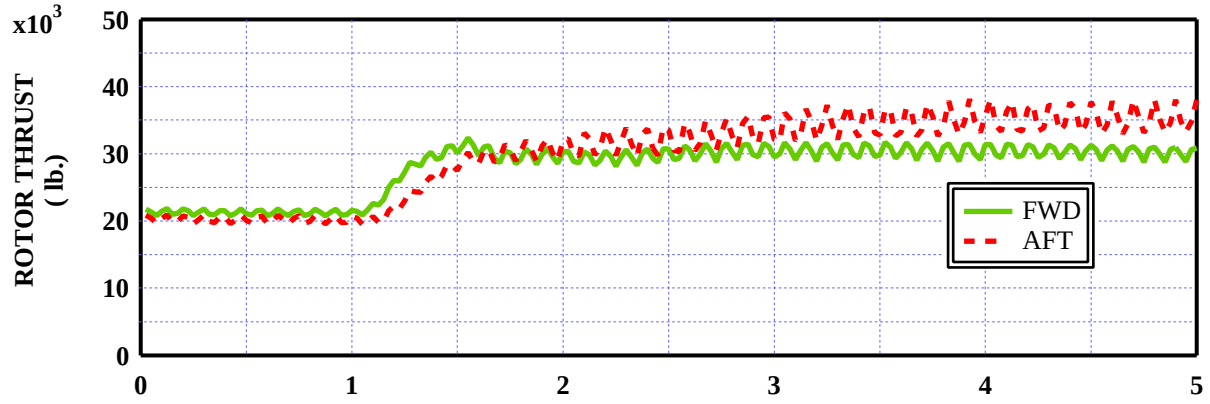


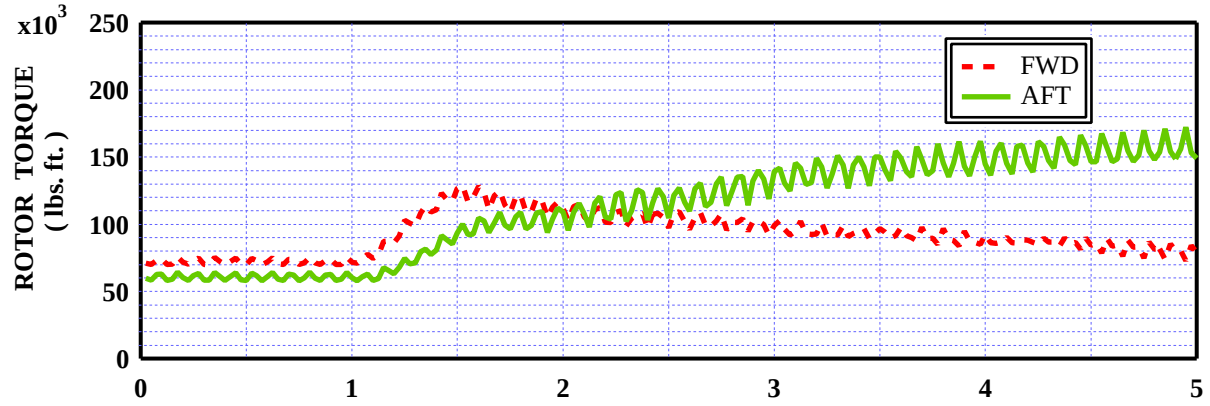
HC MK II SIMULATED CONTROL RESPONSE

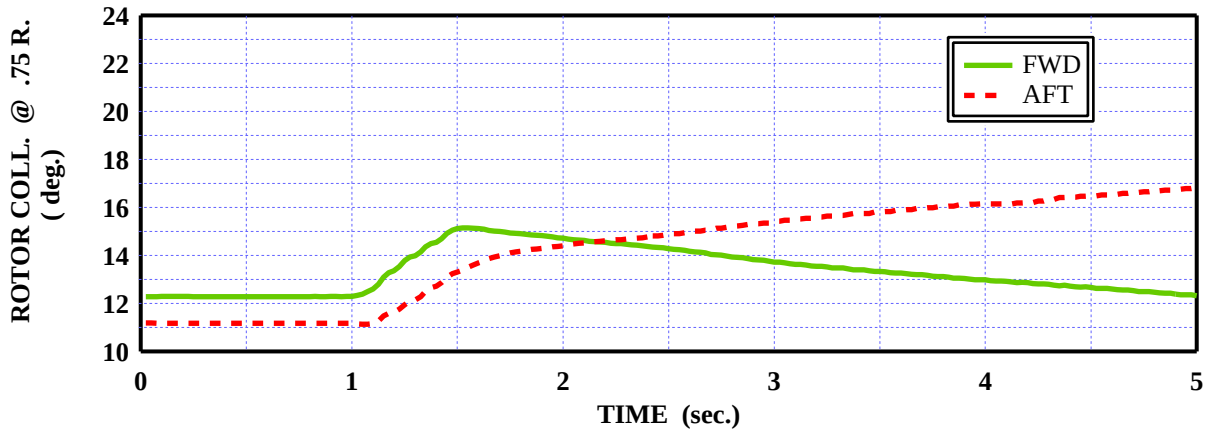
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

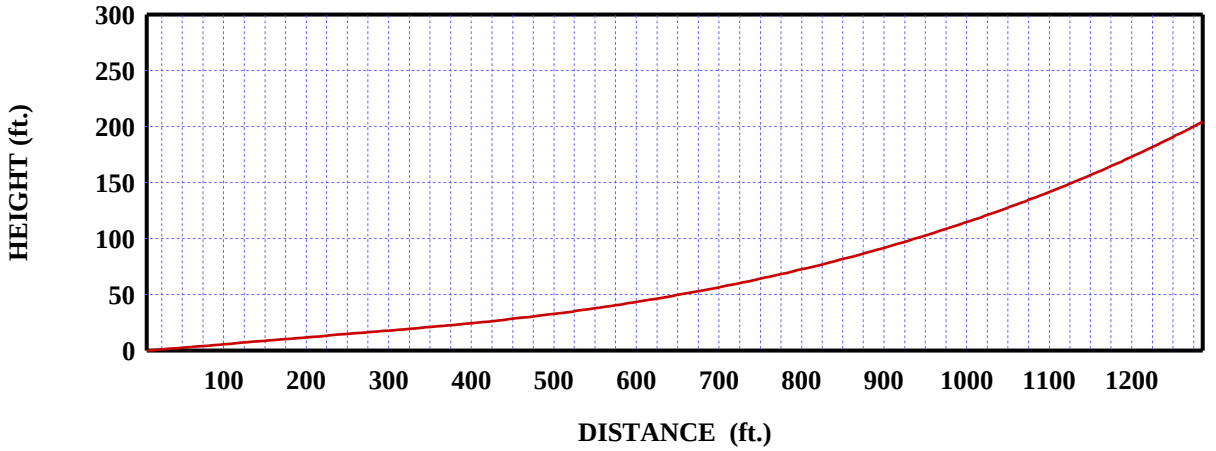
CASE 40 - 1 K

CYCLIC TRIM: ADVANCED







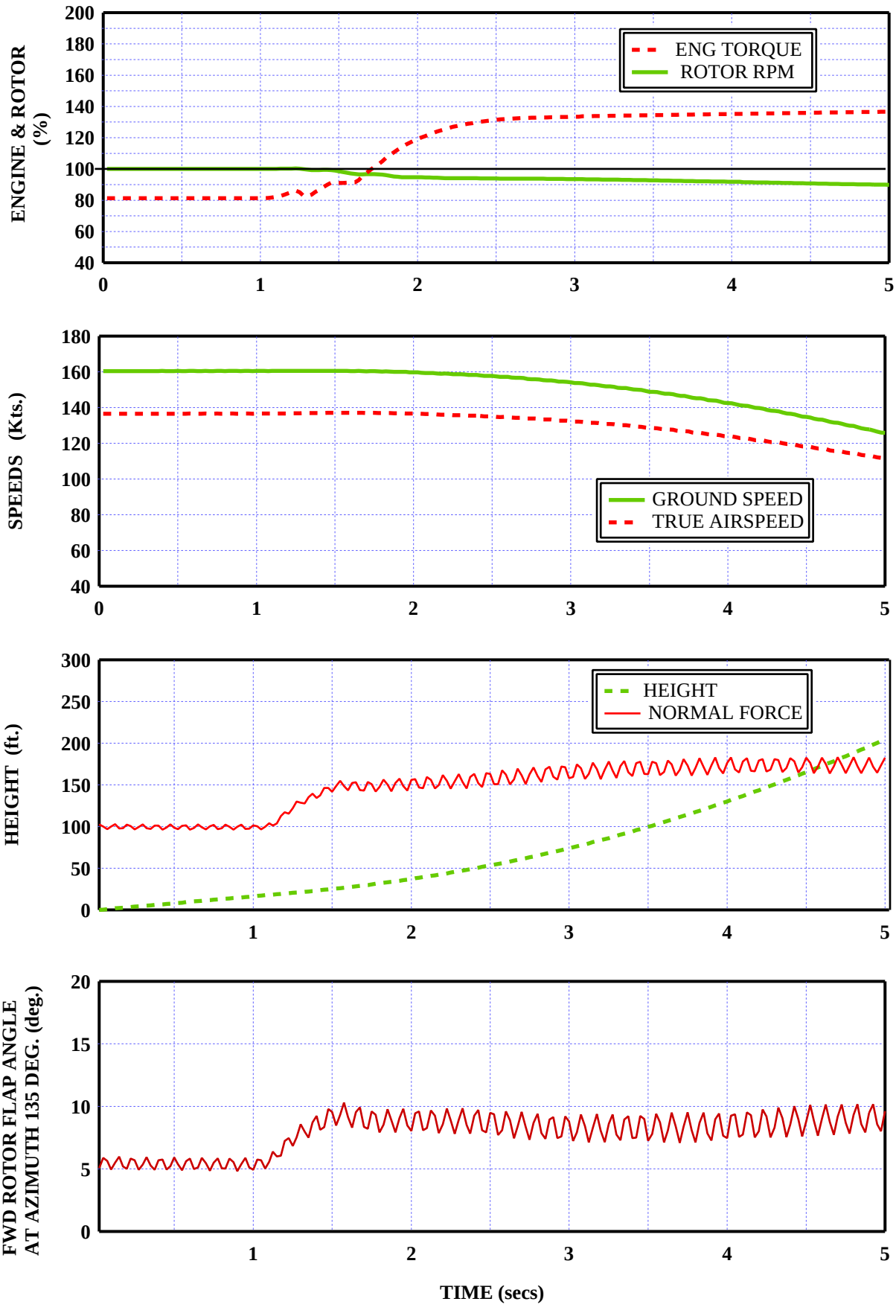


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 40 - 1 K

CYCLIC TRIM: ADVANCED

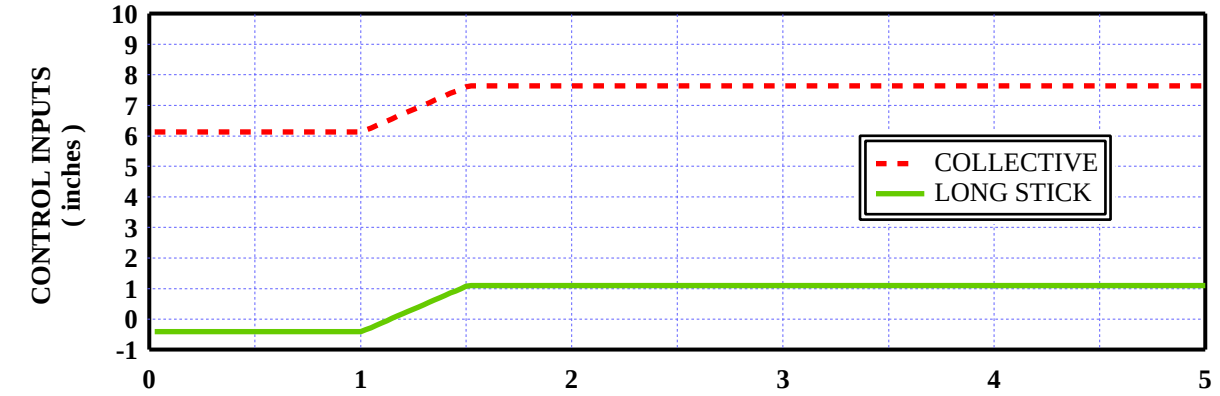


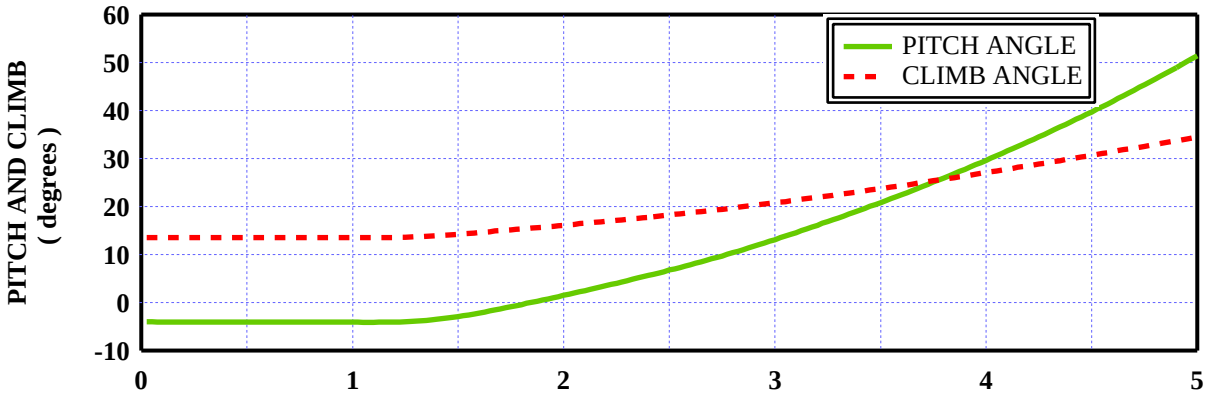
HC MK II SIMULATED CONTROL RESPONSE

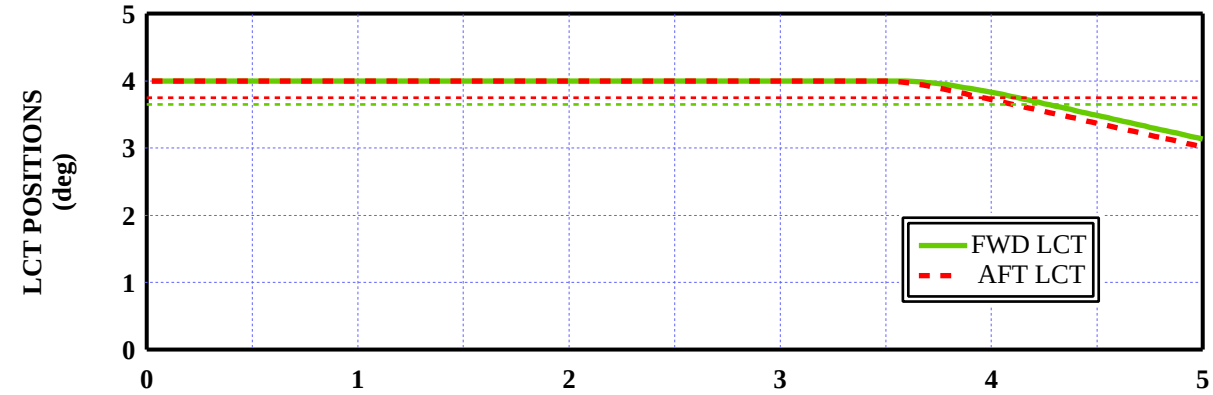
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

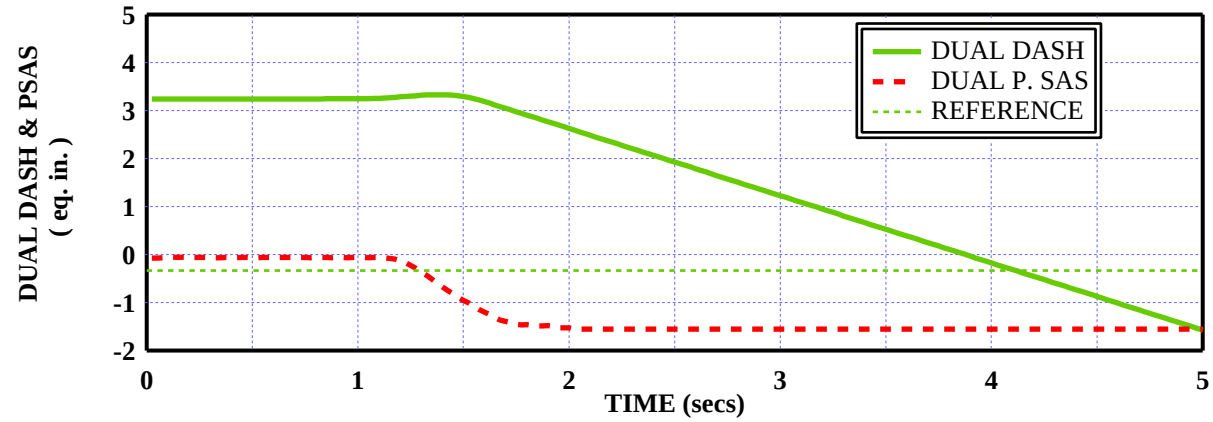
CASE A 07

CYCLIC TRIM: ADVANCED







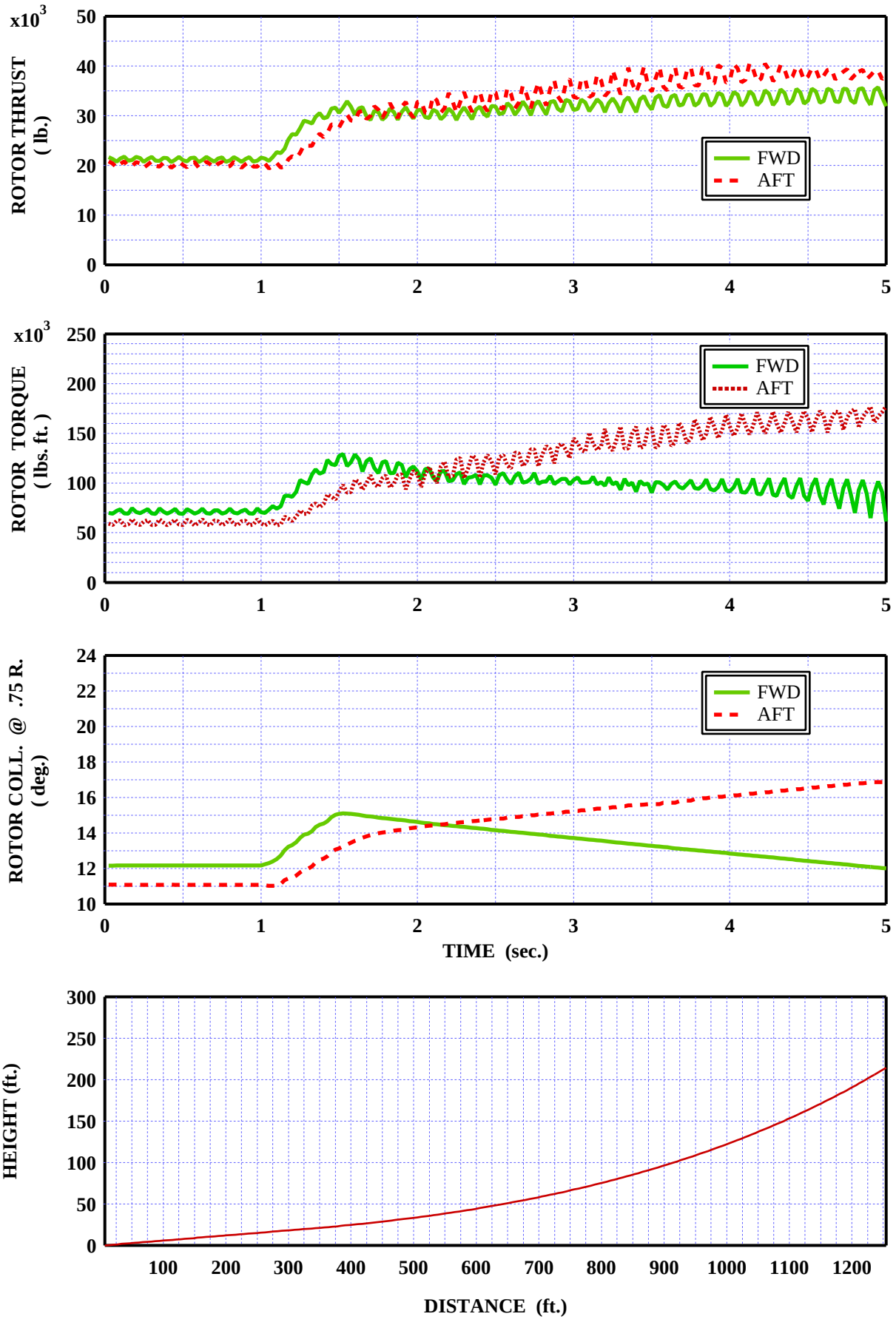


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 07

CYCLIC TRIM: ADVANCED

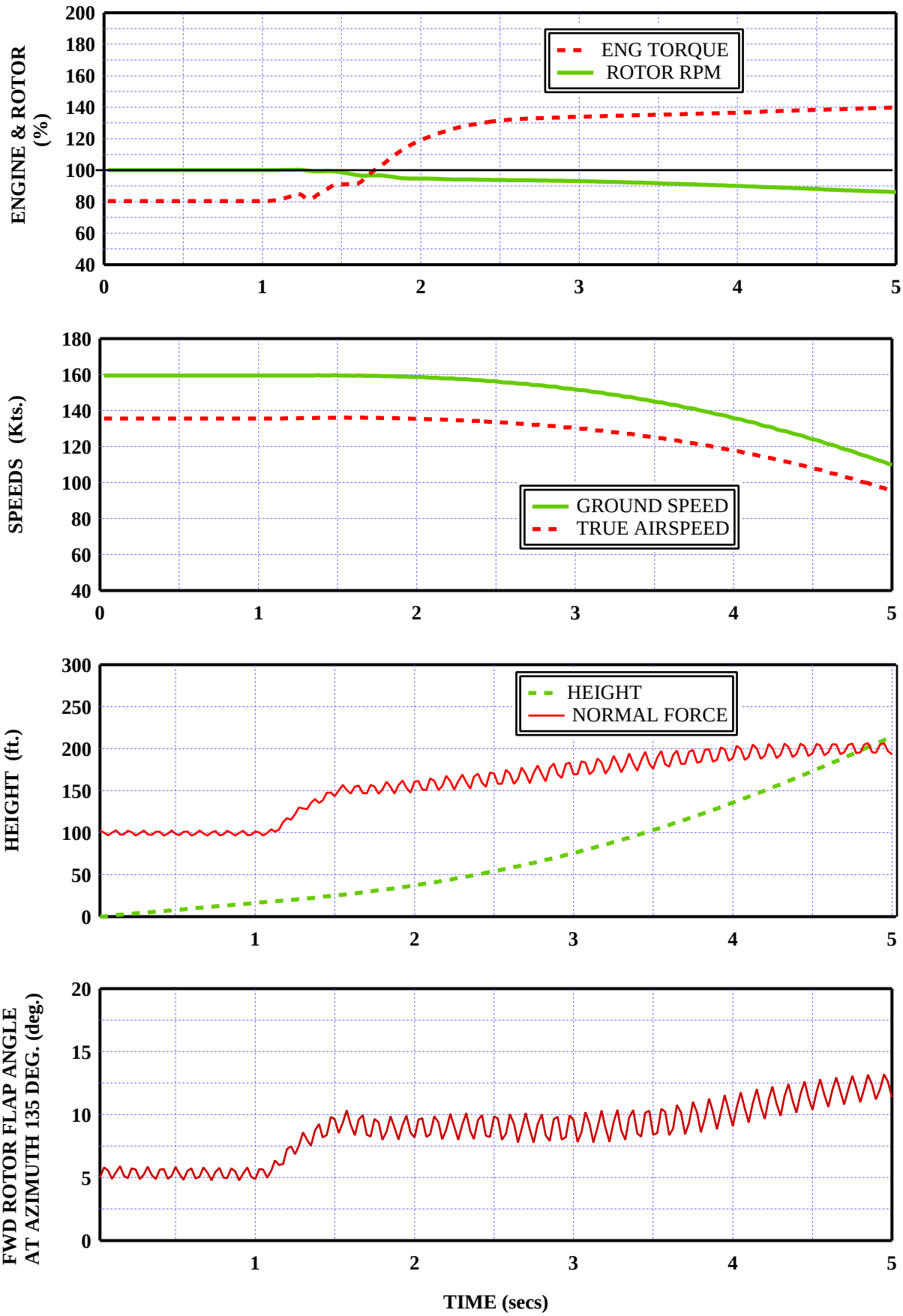


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 07

CYCLIC TRIM: ADVANCED

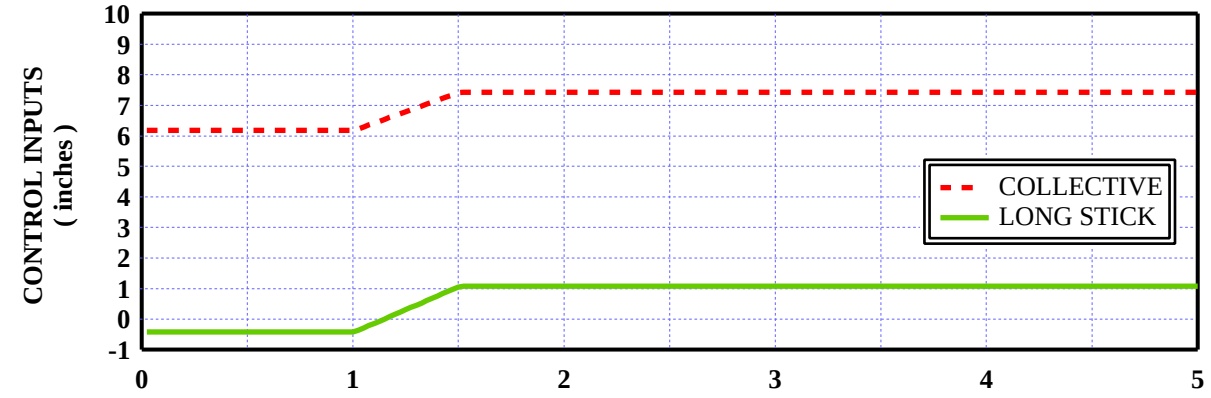


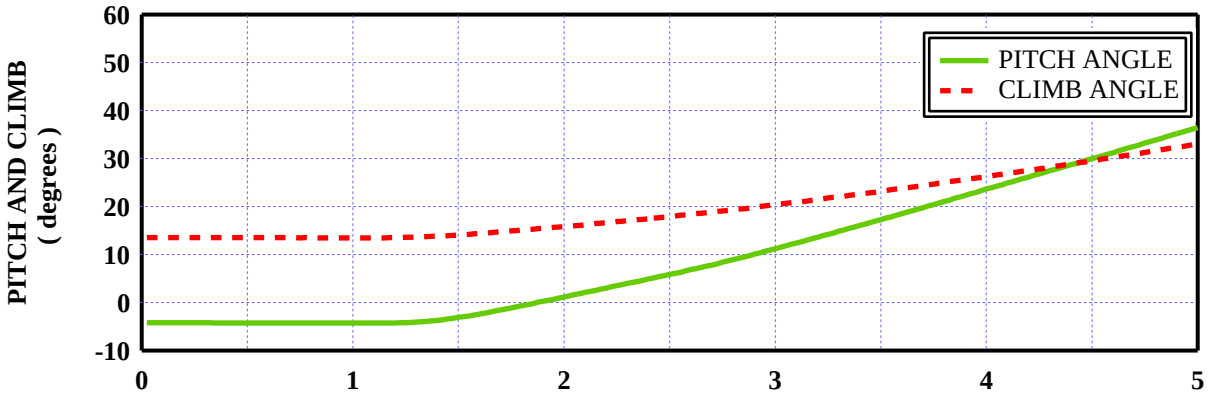
HC MK II SIMULATED CONTROL RESPONSE

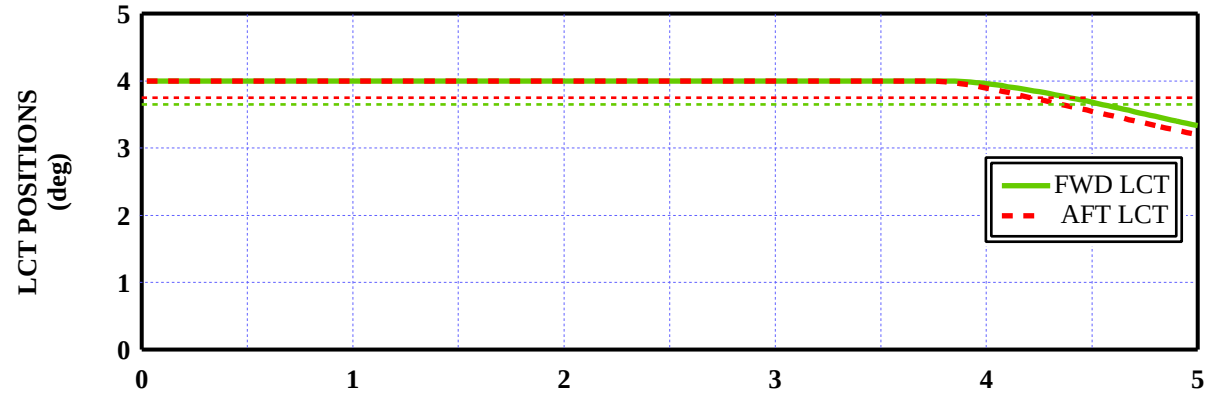
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

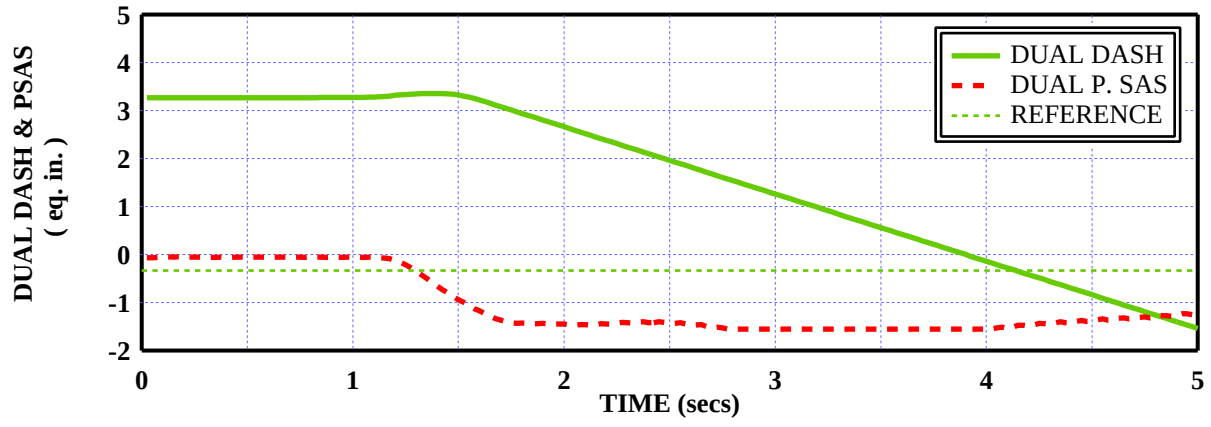
CASE 38_1K

CYCLIC TRIM: ADVANCED







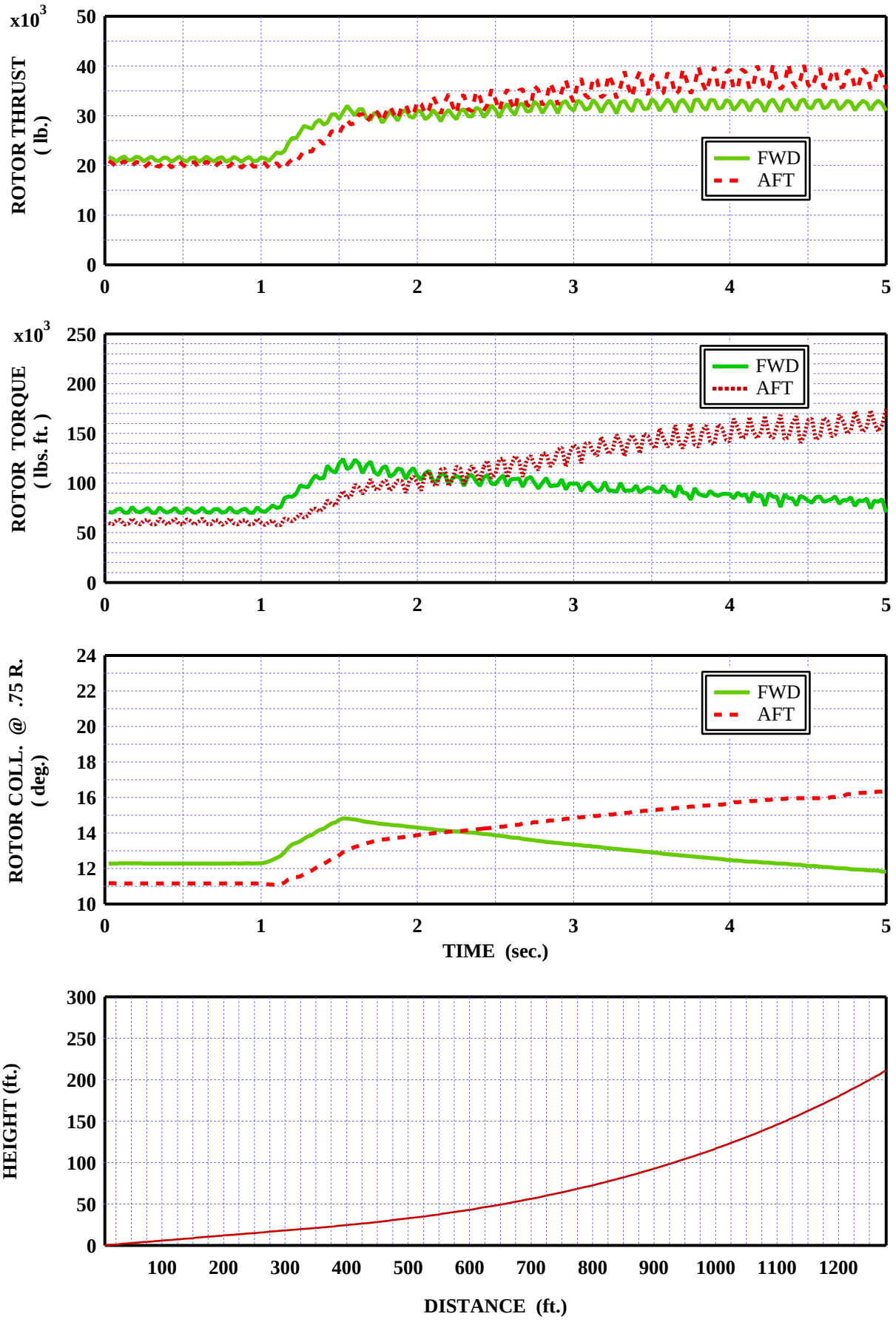


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 38

CYCLIC TRIM: ADVANCED

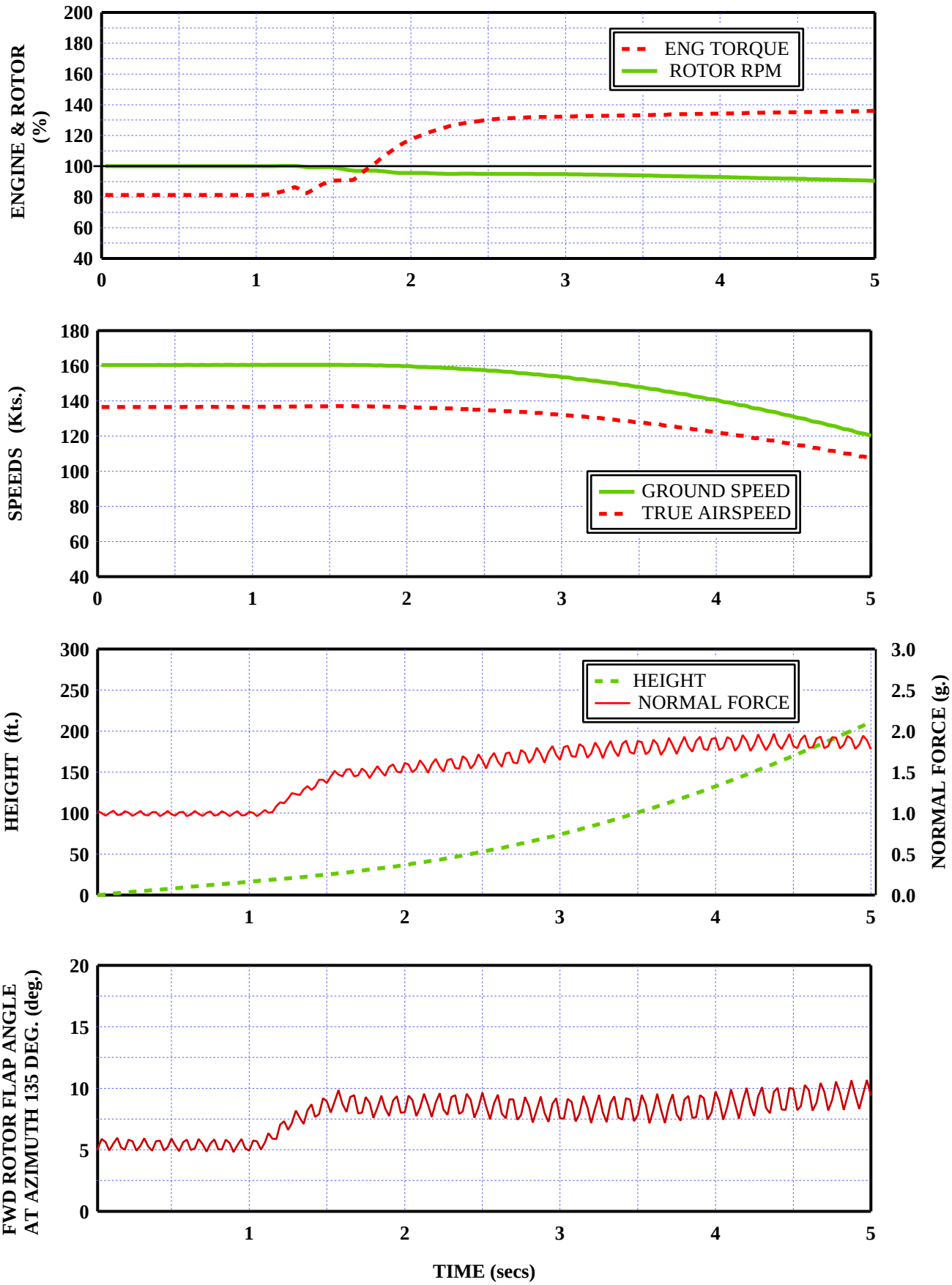


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 38

CYCLIC TRIM: ADVANCED

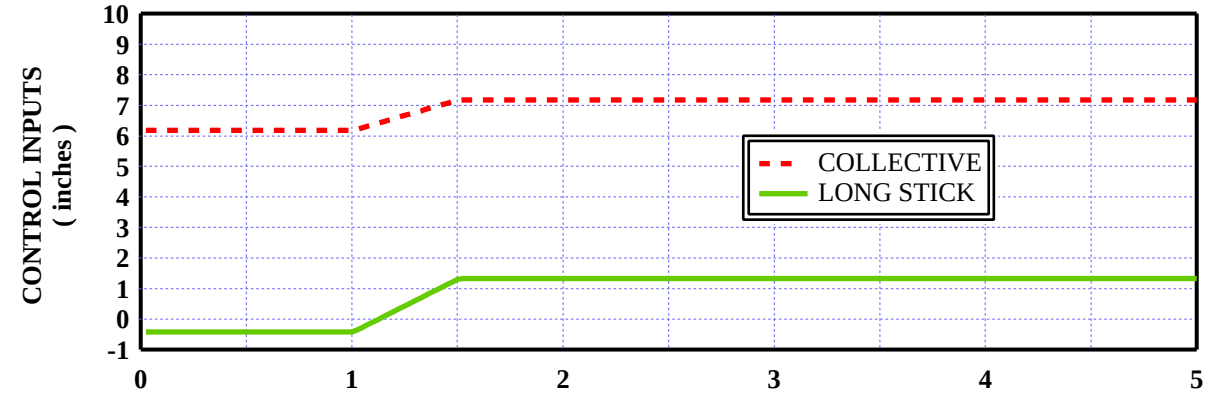


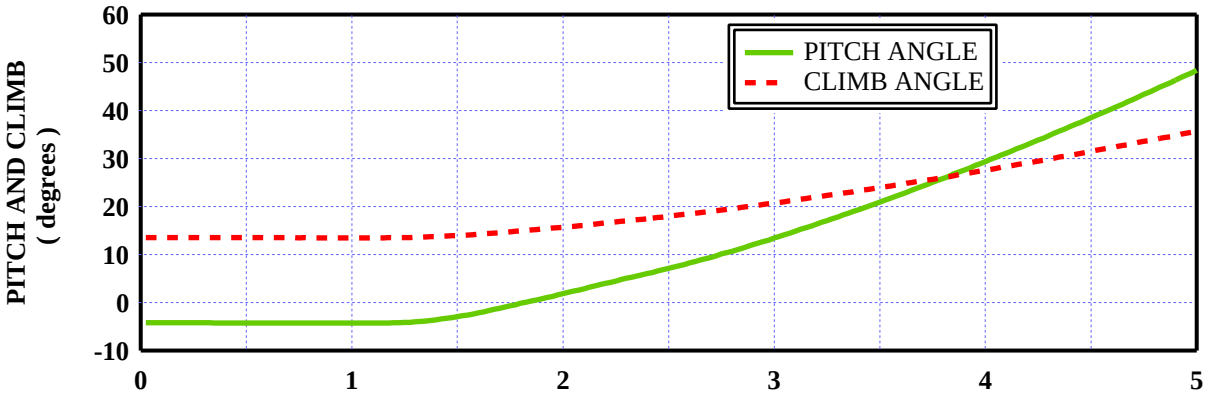
HC MK II SIMULATED CONTROL RESPONSE

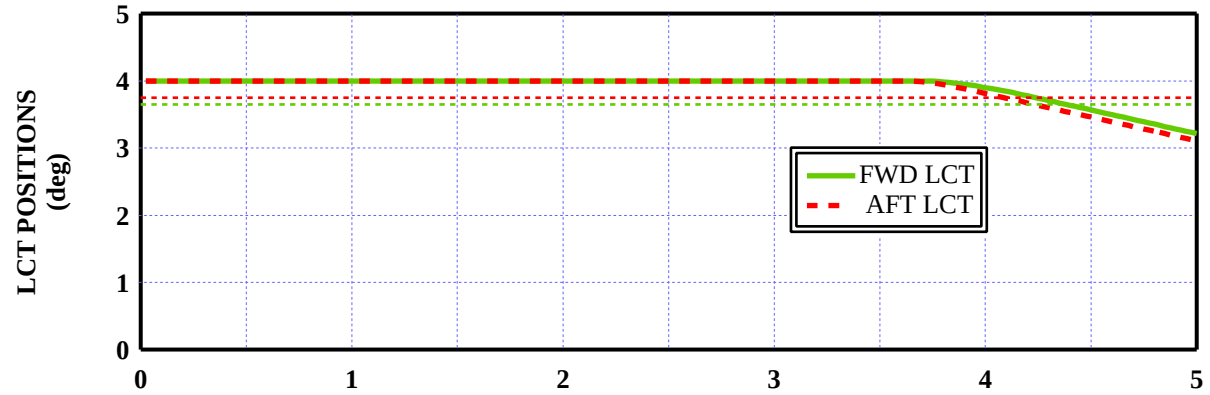
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

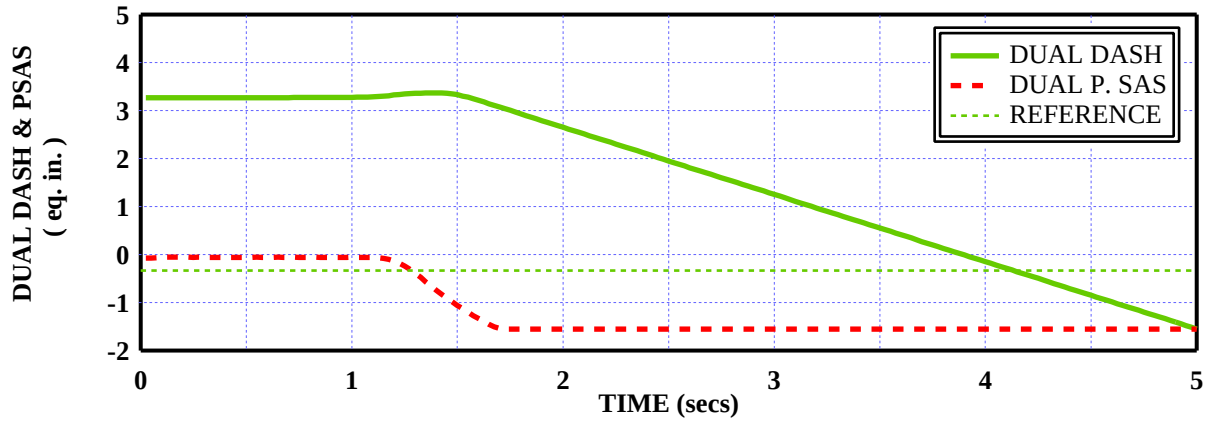
CASE 36_1K

CYCLIC TRIM: ADVANCED







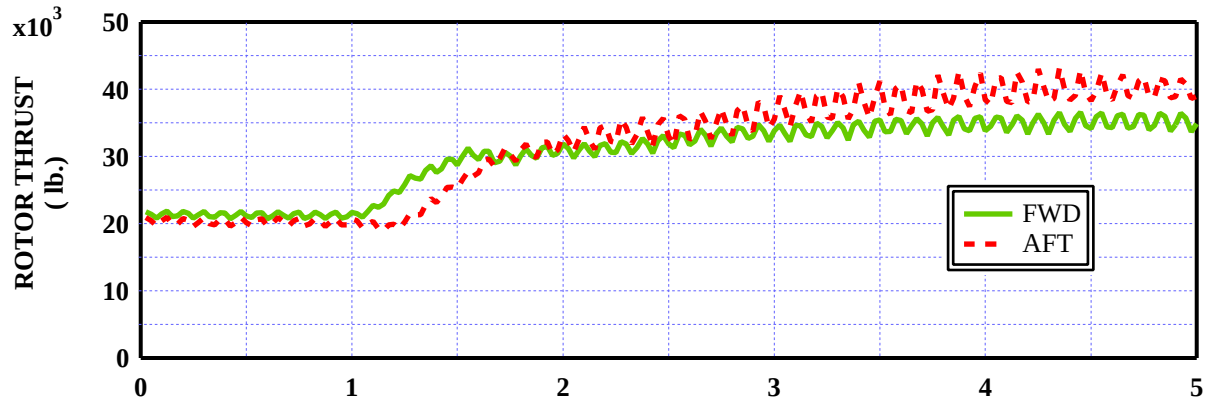


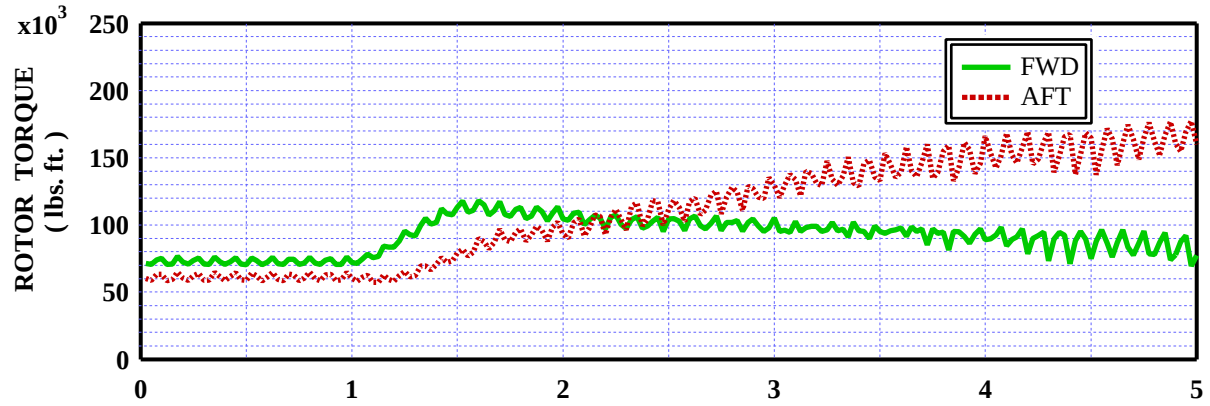
HC MK II SIMULATED CONTROL RESPONSE

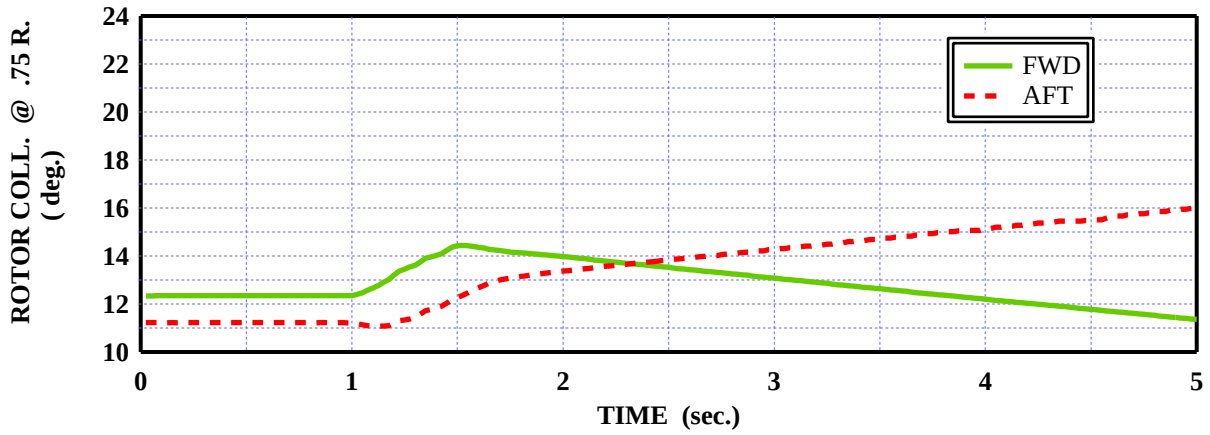
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

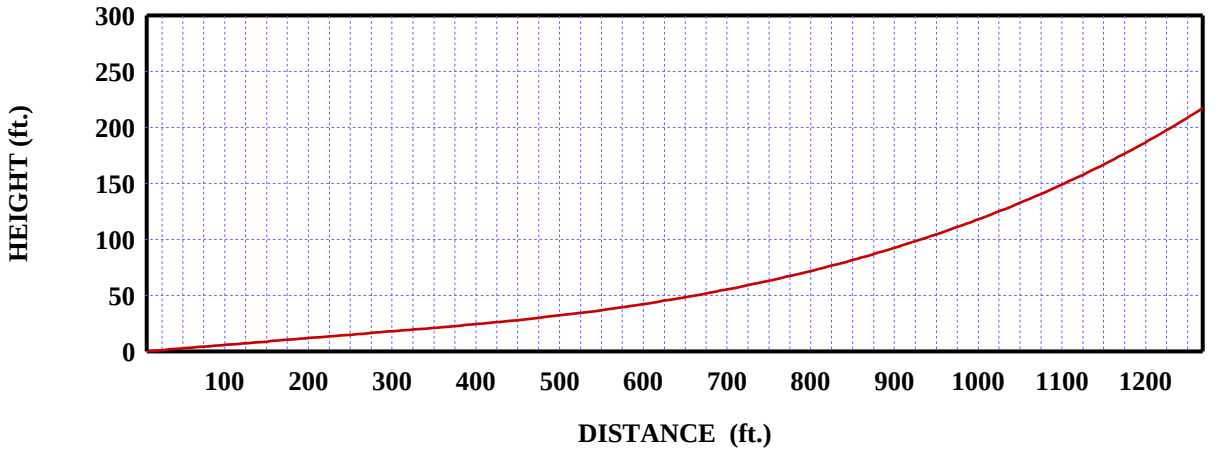
CASE 36-1k

CYCLIC TRIM: ADVANCED







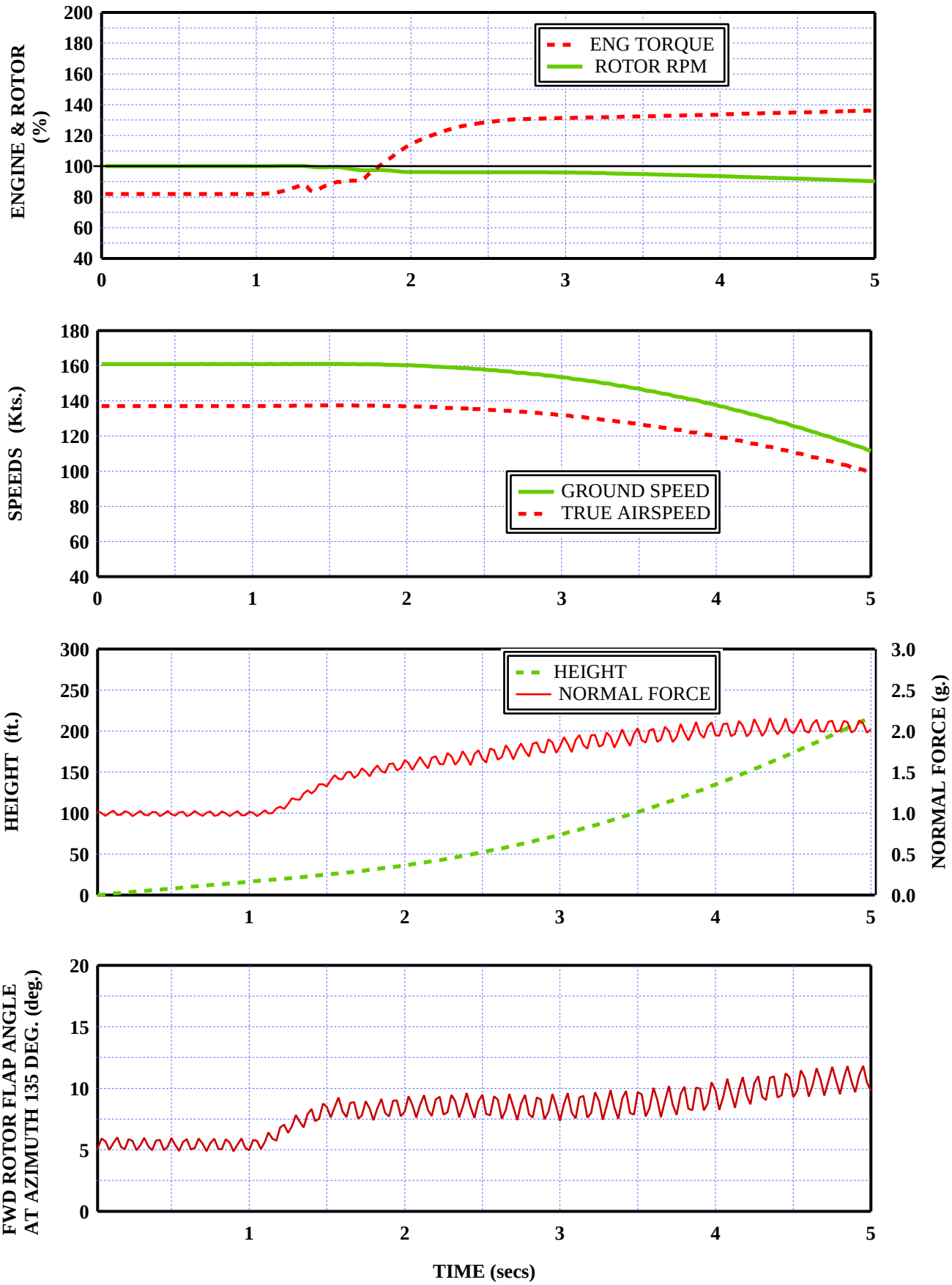


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 36-1k

CYCLIC TRIM: ADVANCED

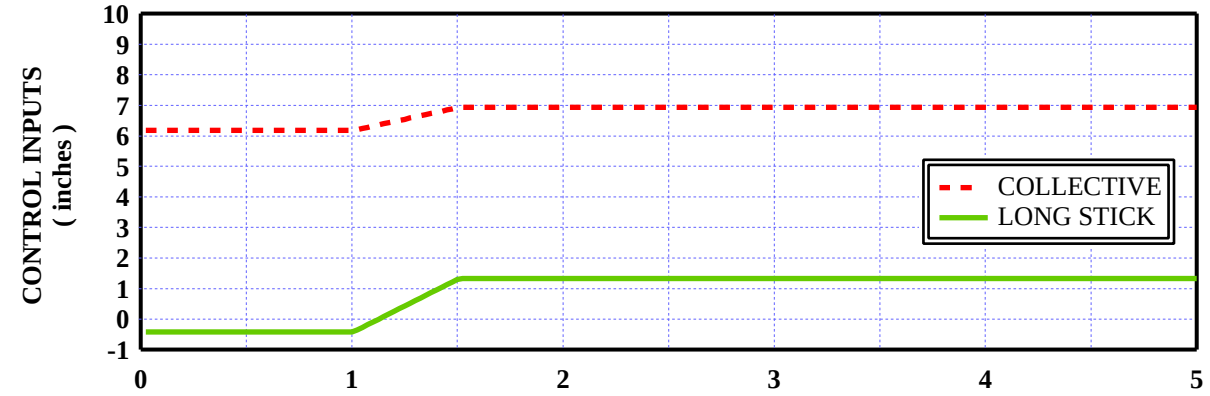


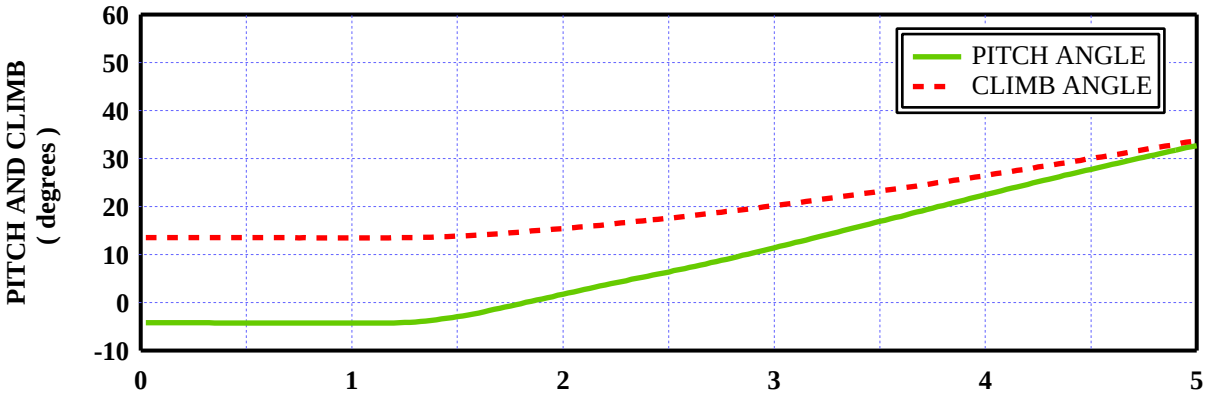
HC MK II SIMULATED CONTROL RESPONSE

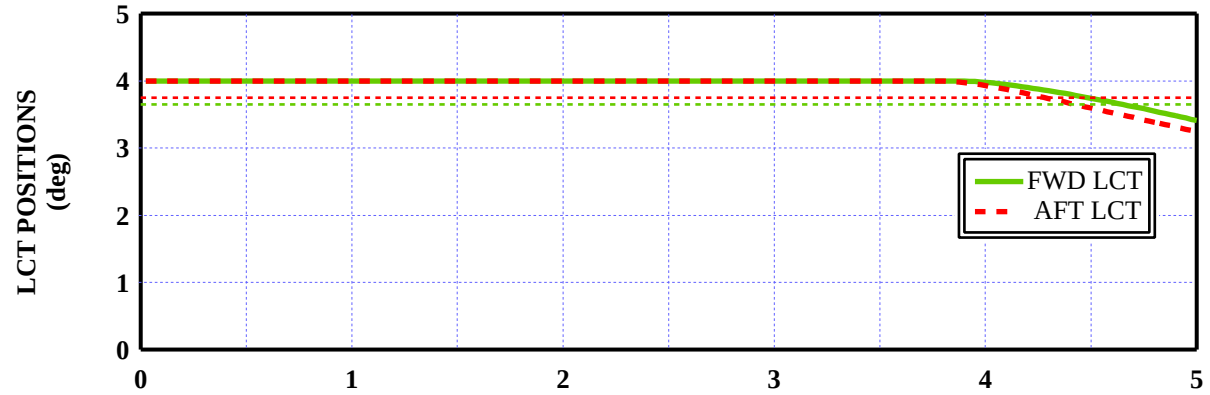
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

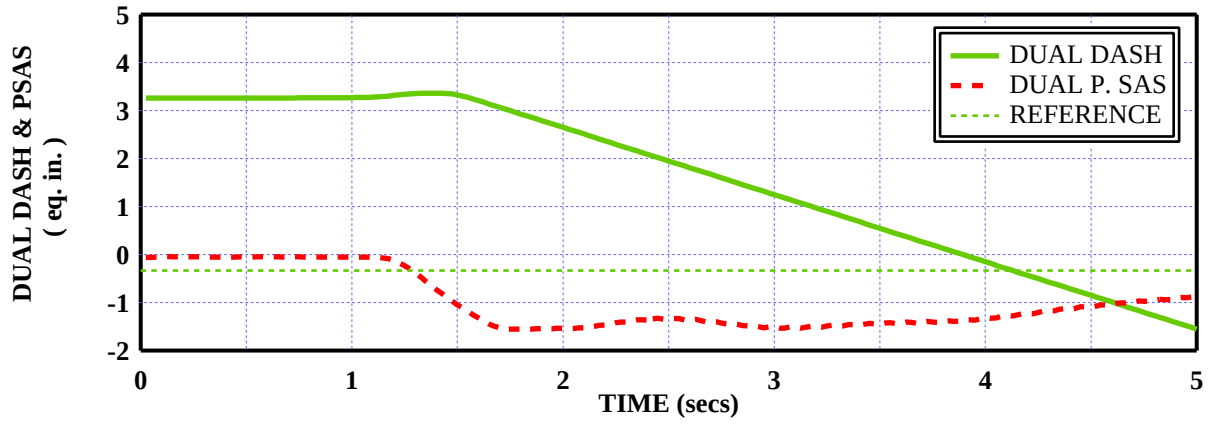
CASE 35_1K

CYCLIC TRIM: ADVANCED







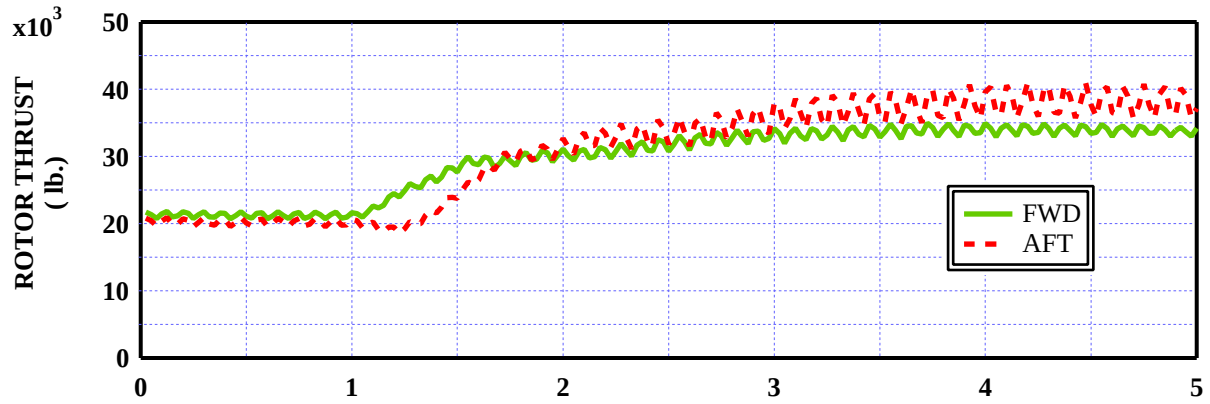


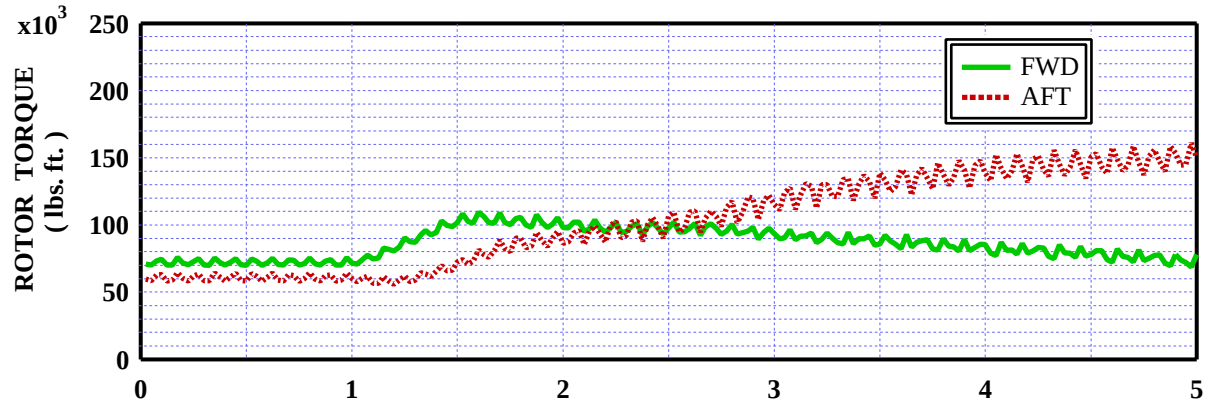
HC MK II SIMULATED CONTROL RESPONSE

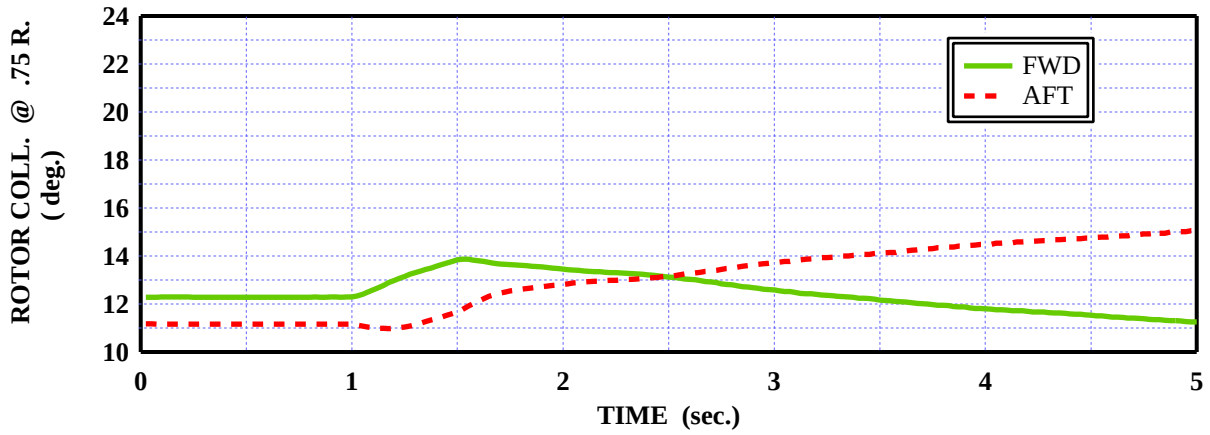
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

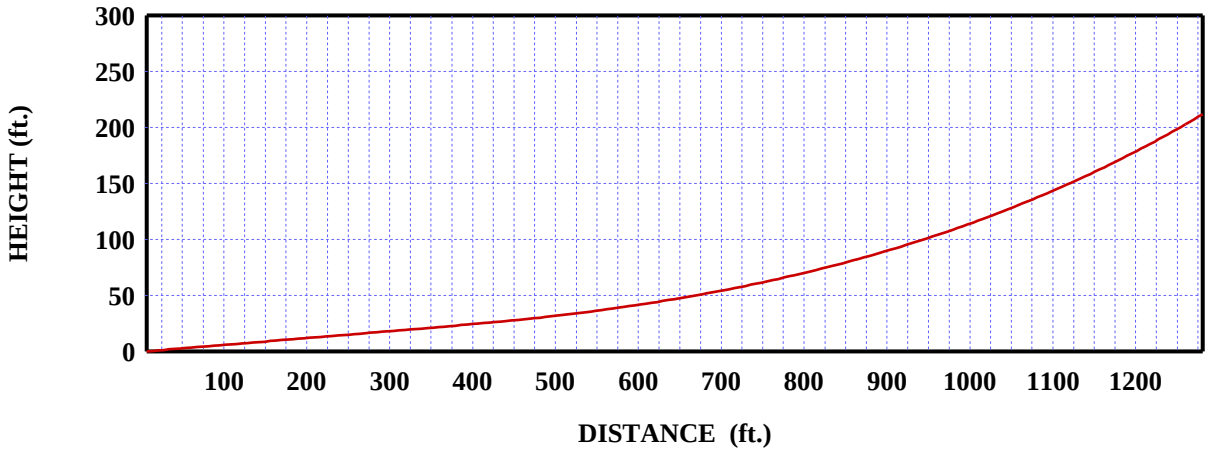
CASE 35

CYCLIC TRIM: ADVANCED







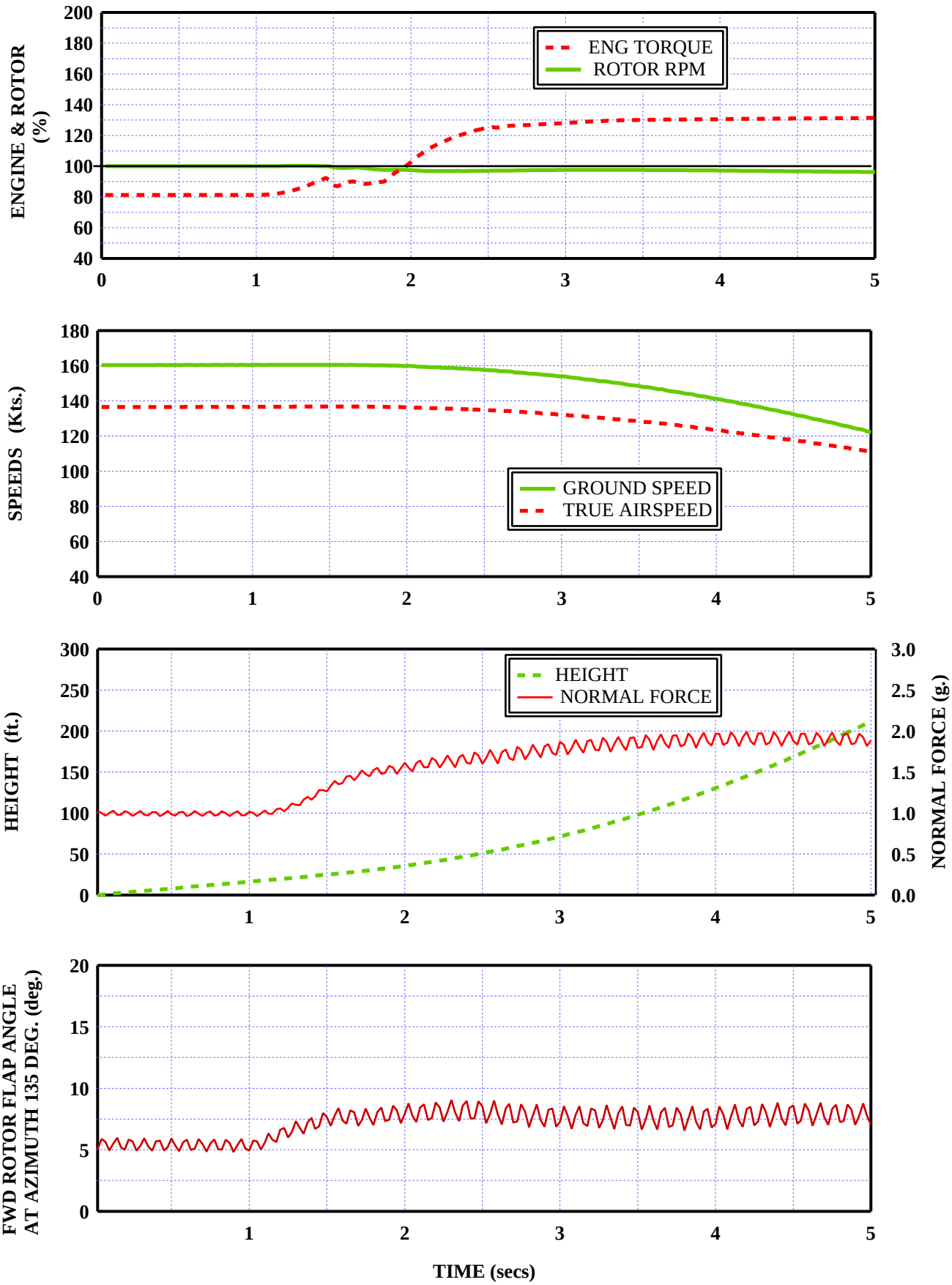


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 35

CYCLIC TRIM: ADVANCED

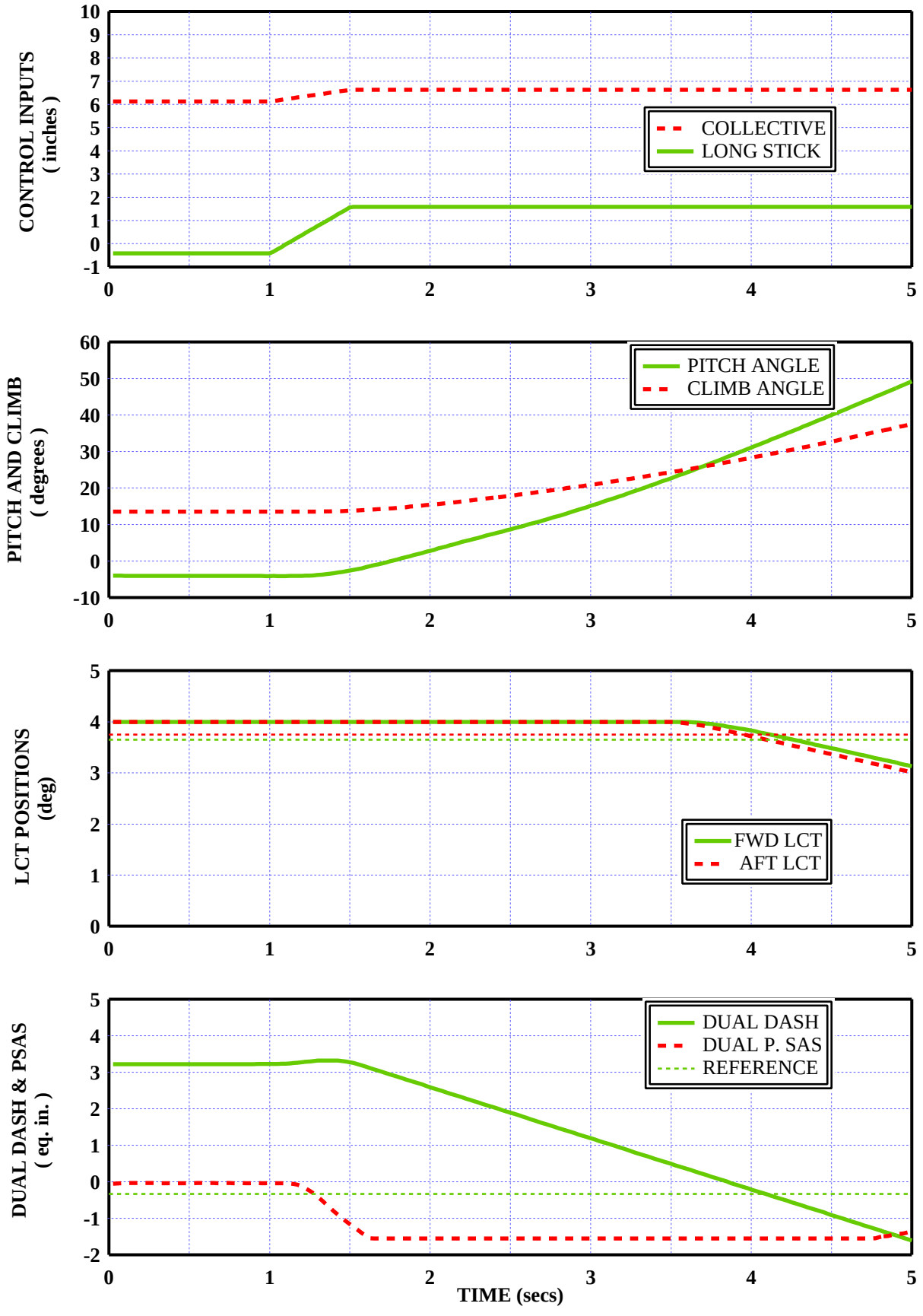


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 24

CYCLIC TRIM: ADVANCED

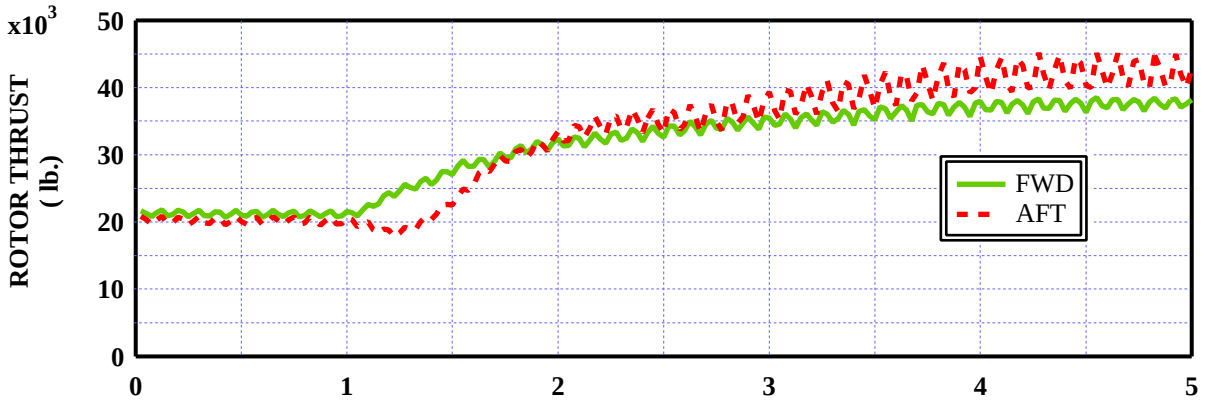


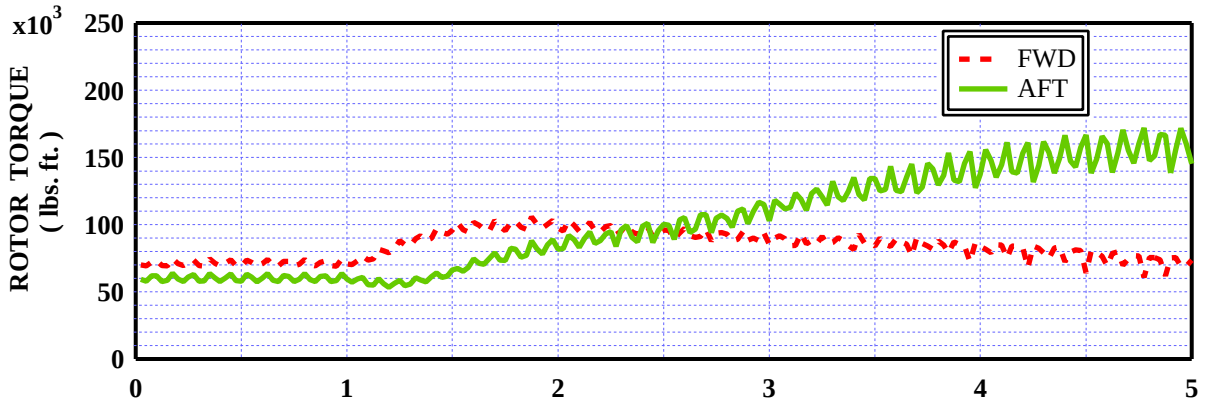
HC MK II SIMULATED CONTROL RESPONSE

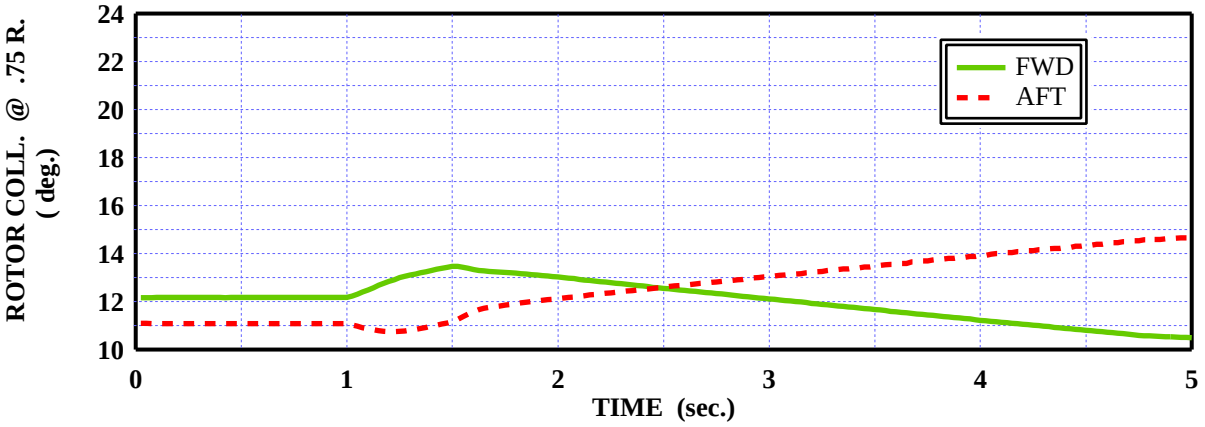
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

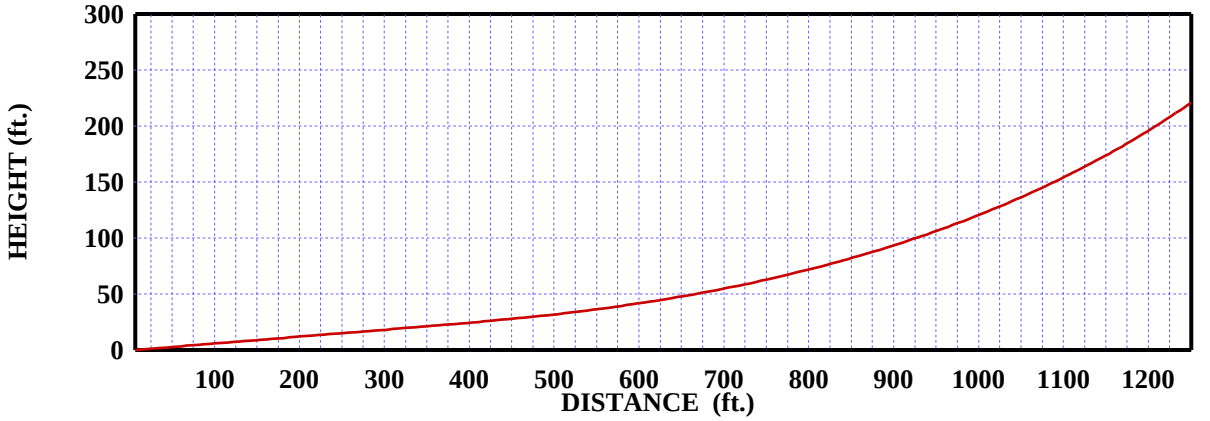
CASE A 24

CYCLIC TRIM: ADVANCED







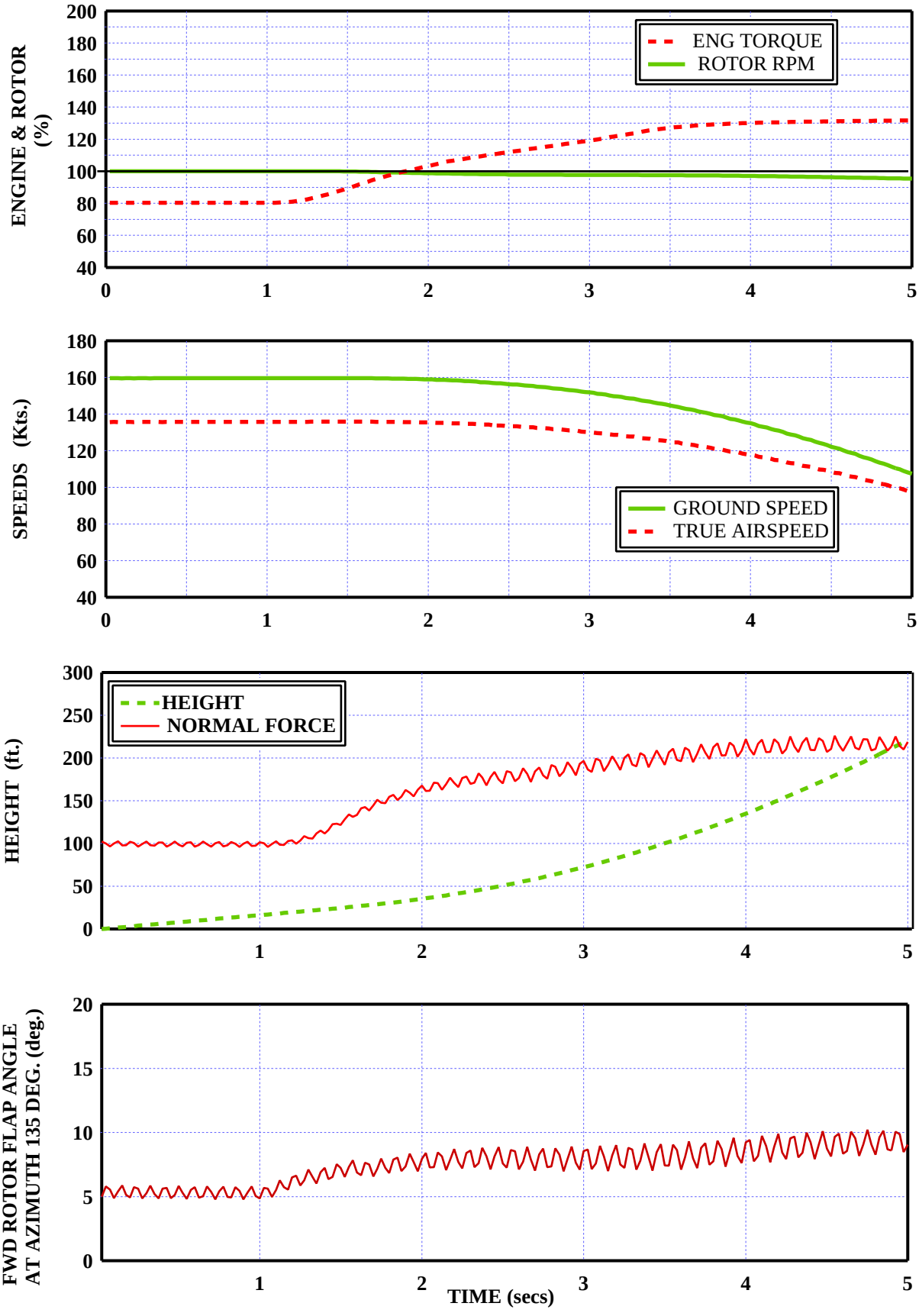


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE A 24

CYCLIC TRIM: ADVANCED

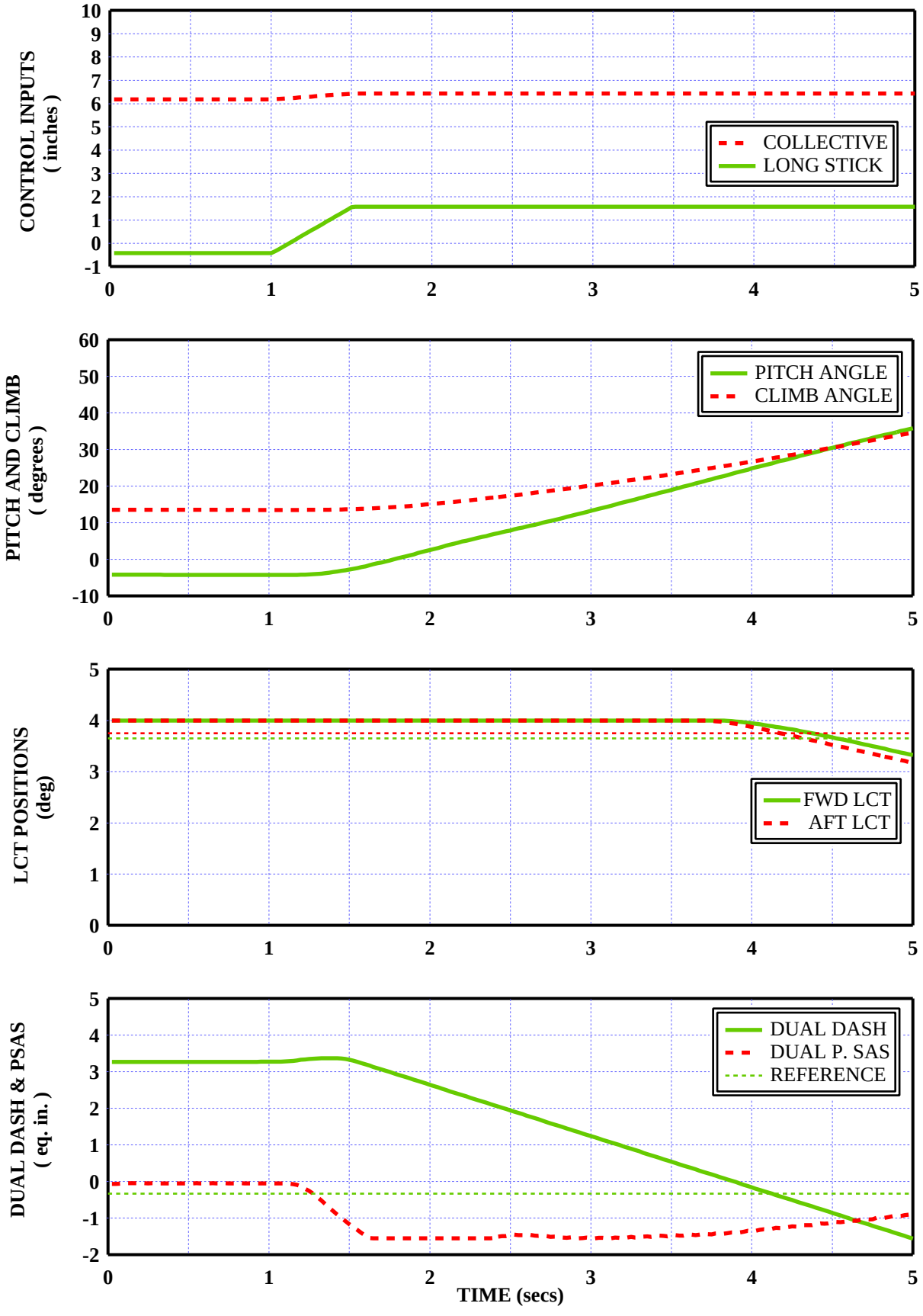


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 32_1k

CYCLIC TRIM: ADVANCED

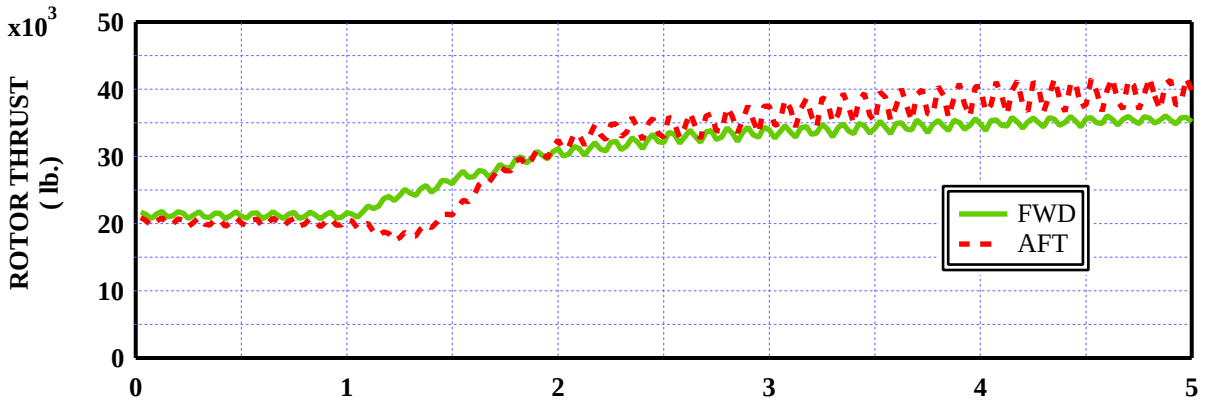


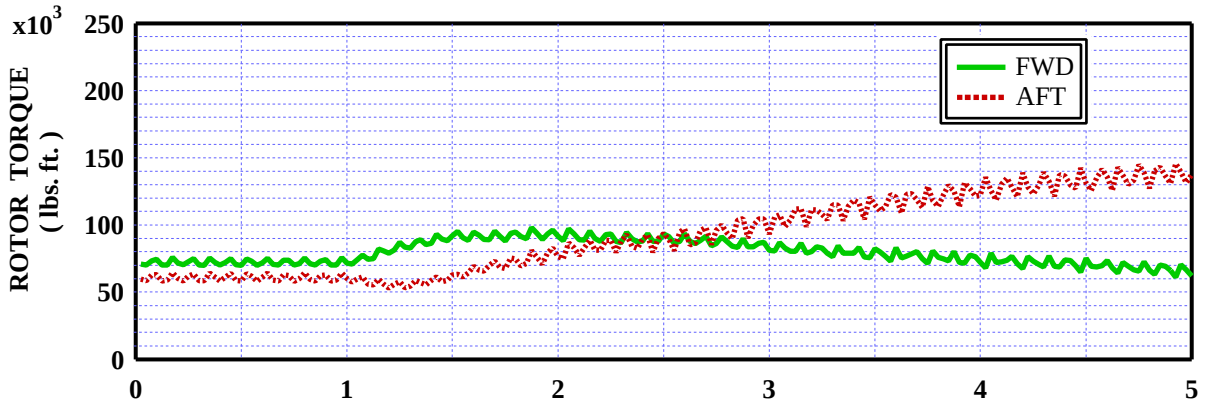
HC MK II SIMULATED CONTROL RESPONSE

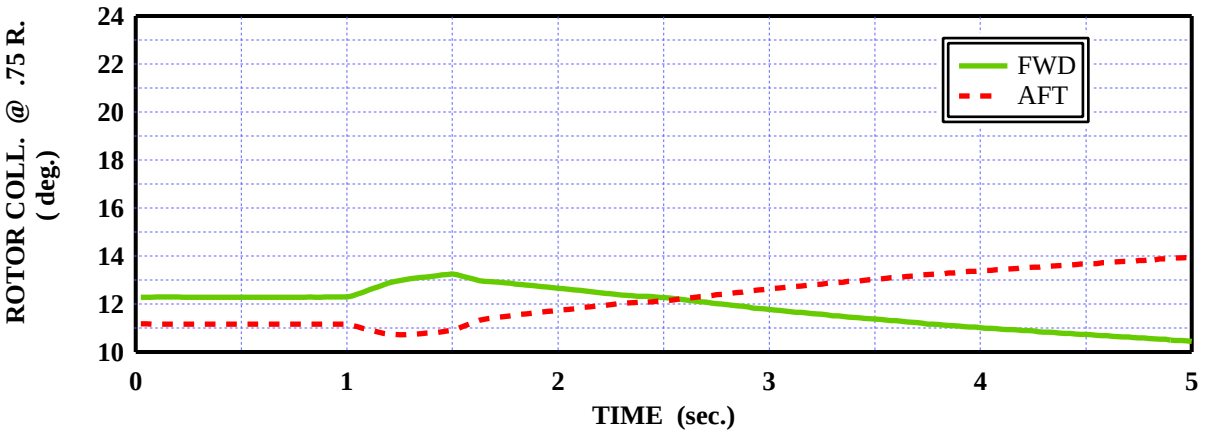
INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

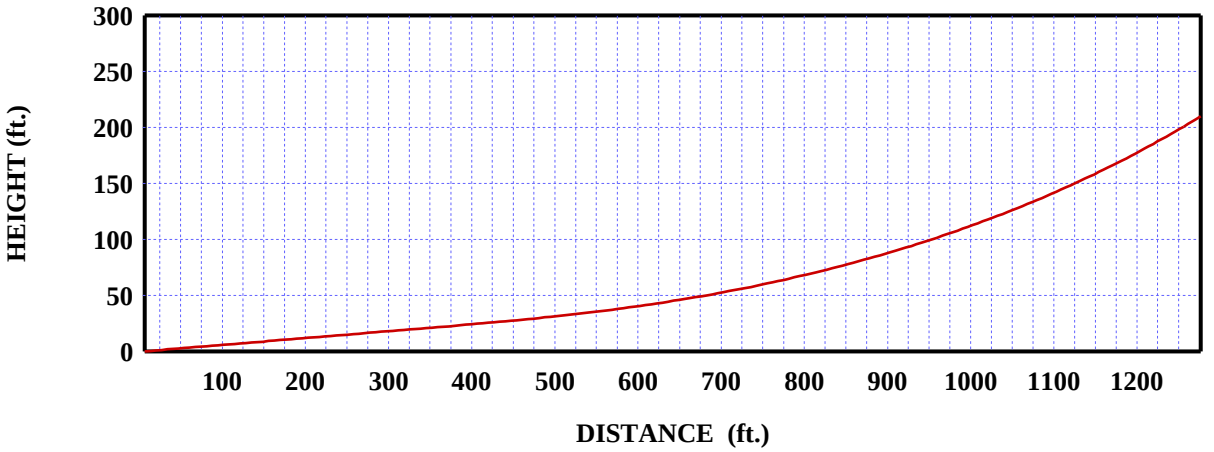
CASE 32

CYCLIC TRIM: ADVANCED







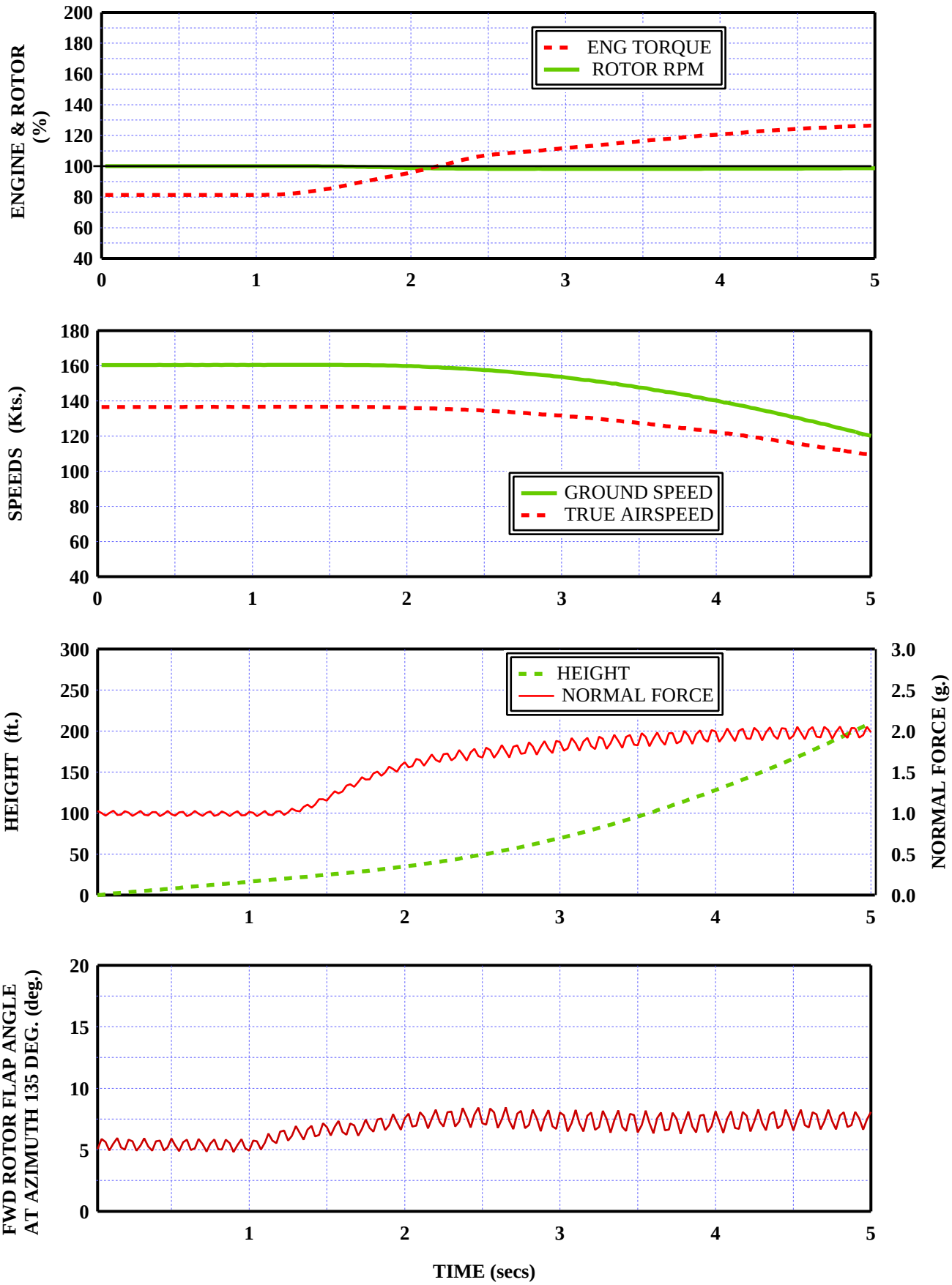


HC MK II SIMULATED CONTROL RESPONSE

INITIAL TAS = 135 Kts.
INITIAL ROC = 1000 fpm.

CASE 32

CYCLIC TRIM: ADVANCED



APPENDIX C

Catalog of Simulation Results

UNDER SEPARATE COVER