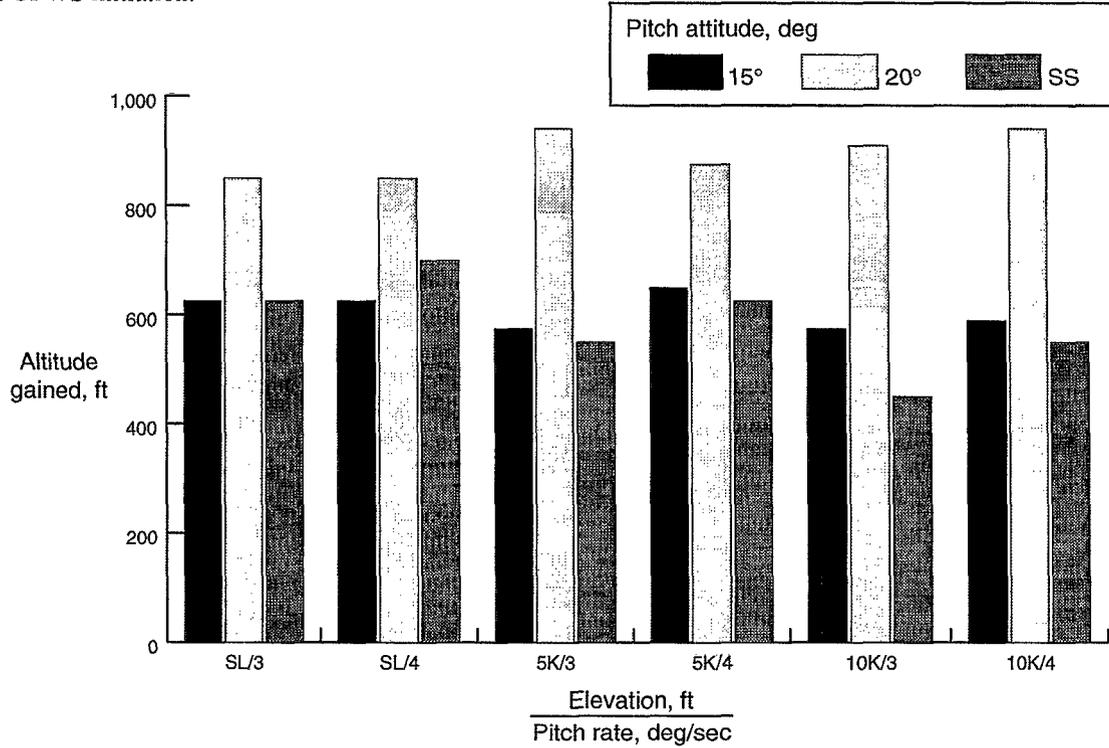


## Introduction

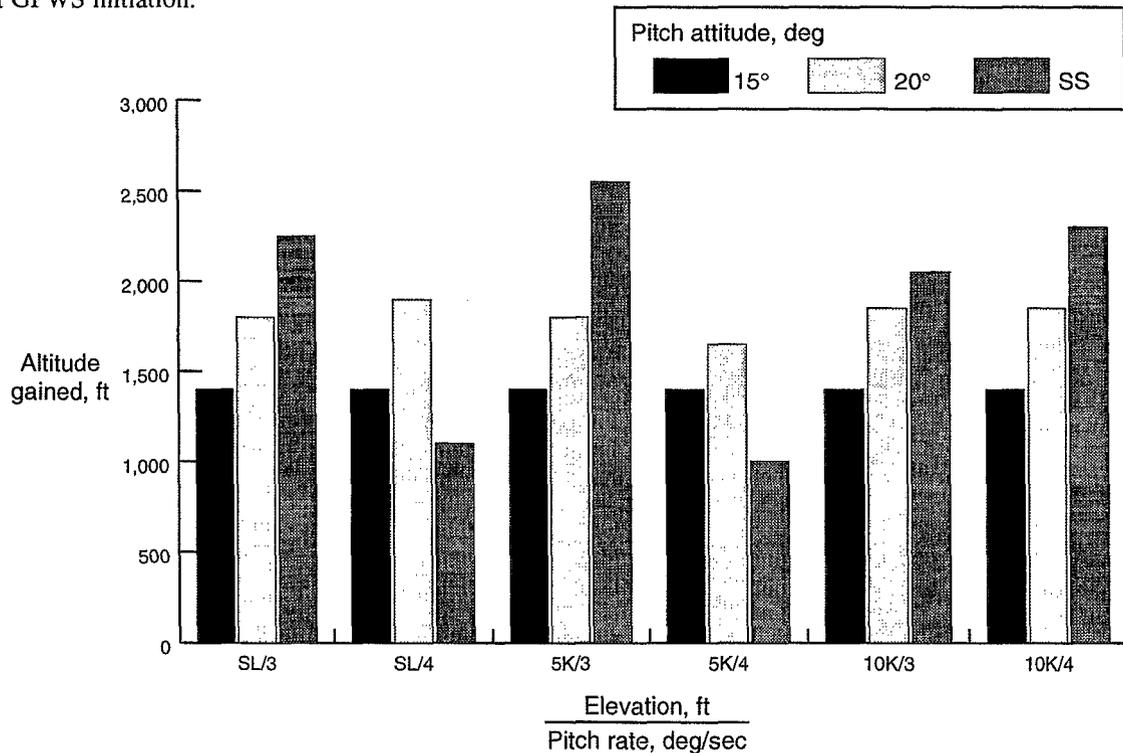
To develop the information provided, seventy two cases were defined from four standard scenarios. Various combinations of altitude, pitch rate, and pitch attitude were run through a simulation program which utilized the MD-11 Aerodynamic Model. Time history plots for each case were generated using the following parameters: velocity, altitude, elevator deflection, pitch attitude, pitch rate, alpha, elevator column force, and normal acceleration.

The four scenarios are:

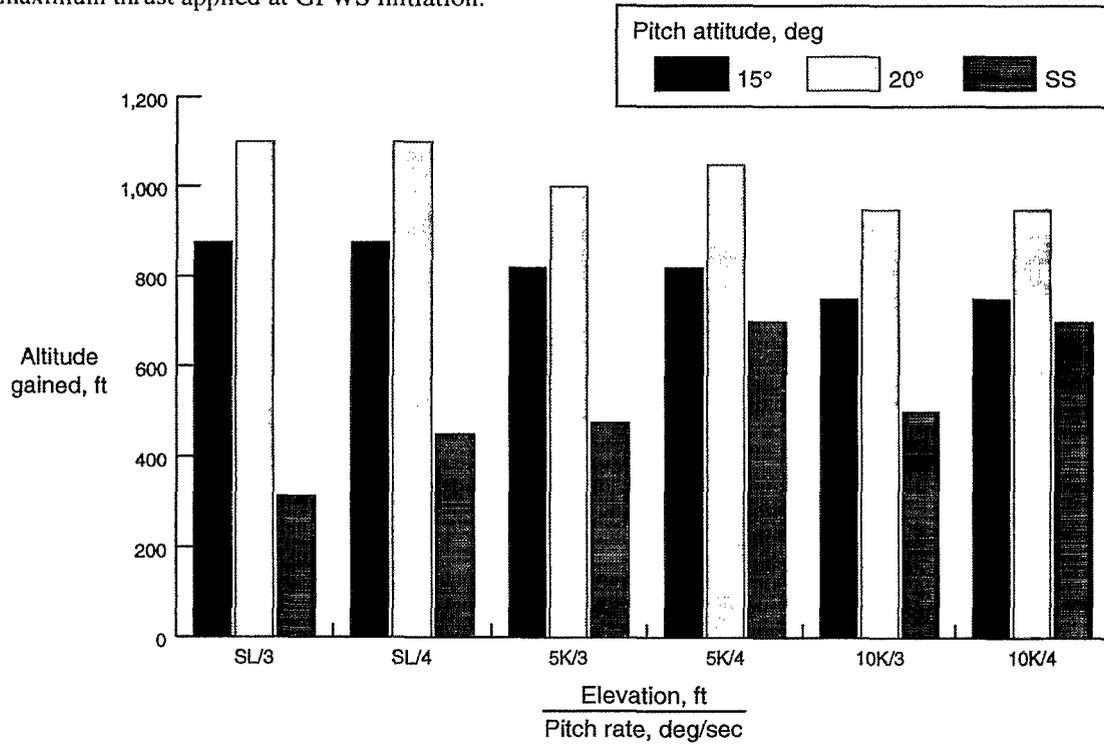
Scenario #1: Maximum takeoff weight; Flaps—takeoff position; Landing gear—up; Speed—V2; Thrust—maximum thrust applied at GPWS initiation.



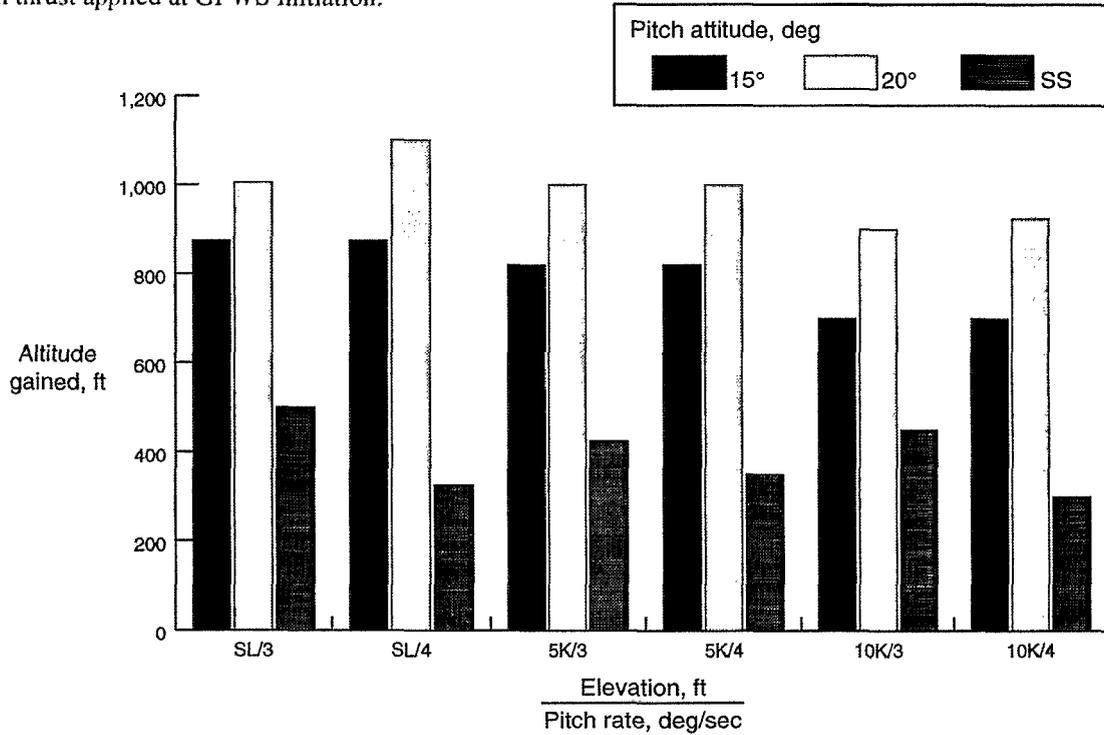
Scenario #2: Maximum landing weight; Flaps—up; Landing gear—up; Speed—maneuvering; Thrust—maximum thrust applied at GPWS initiation.



Scenario #3: Maximum landing weight; Flaps—approach position; Landing gear—down; Speed—minimum flap speed; Thrust – maximum thrust applied at GPWS initiation.



Scenario #4: Maximum landing weight; Flaps—landing position; Landing gear—down; Speed – Vref + 5; Thrust – maximum thrust applied at GPWS initiation.



All scenarios were run with rotation rates of 3° per second and 4° per second with 15°, 20°, and stick shaker (SS) initiation nose up attitudes. All scenarios were run at sea level, 5,000 feet, and 10,000 feet altitudes.

## **Results**

Utilizing a rotation rate of 3° to 4° per second (about the same as a normal takeoff rotation rate) to a pitch attitude of 20° results in the best altitude gain over a given time period in almost all cases.

Although the data was computed with the MD-11 Aerodynamic Model, it is estimated that the trends for all Douglas Commercial Jet aircraft are roughly the same.

## **Conclusion**

Under certain conditions of flight where immediate visual reference to surrounding terrain is not available, prompt and decisive action is required for a GPWS warning.

Caution: Do not ignore short duration warnings. Take immediate and aggressive action.

Flight crews should become familiar with the following sequence of actions and use them immediately and aggressively upon activation of an aural or visual GPWS warning.

Thrust – Disengage the autothrottles and aggressively apply necessary thrust to ensure adequate airplane performance. Avoid engine overboost unless necessary to avoid ground contact. When airplane safety has been ensured, adjust thrust to maintain engine parameters within normal limits.

Autopilot – Disengage the autopilot.

Pitch – Immediately rotate the airplane at a rate of 3° per second (similar to a normal takeoff rotation rate) to 20° pitch attitude. Trade airspeed for climb performance. If necessary (to prevent ground contact), continue to increase pitch attitude until stick shaker actuates. In this situation, consider use of engine overboost by moving throttles to their mechanical limits. Although there are no pitch limitations in emergency conditions, caution must be exercised to keep from maintaining pitch attitudes that result in continuous actuation of stick shaker.

Speed Brakes – Retract speed brakes.

Flight Director – Turn flight director off or disregard commands.

Level the wings to assure maximum airplane performance.

At positive climb rate (when radio altimeter shows an increasing altitude), retract landing gear (if extended).

After GPWS warning ceases, continue climb to published minimum safe altitude.

## **Revisions**

The material in this section is considered accurate; however, since it is intended to be informative only, it should not be consulted in lieu of official operating manuals.