SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

DEPARTMENT OF AEROSPACE ENGINEERING

Subject Code & Name**: 19AST302 FLIGHT DYNAMICS** **Date: 12.10.2023**

DAY: **36** TOPIC:**RUDDER LOCK**

The floating angle of the rudder, as given by Eq. (3.322), depends on the hinge-moment parameters $C_{h\beta}$ and $C_{h\delta r}$. As said earlier, with $C_{h\beta} > 0$ and $C_{h\delta r} < 0$, the rudder floating angle δ_{rf} will be positive for positive sideslip. Furthermore, the floating angle increases with sideslip. Schematic variations of the required rudder deflection and floating angle with sideslip are shown in Fig. 3.89. At high sideslip, the floating angle increases beyond the linear rate indicated by Eq. (3.322) because the center of pressure moves aft because of flow separation and stall. This accentuates the floating tendency of the rudder. At one point, the floating angle may catch up with the required rudder deflection. This condition is usually known as rudder lock. Beyond this point, the floating angle may overshoot and opposite pedal forces are required to operate the rudder. Such a situation is undesirable because it may take considerable effort for the pilot to break the rudder lock.

Aerodynamic balancing to prevent rudder lock. As we have discussed before, aerodynamic balancing helps to alter hinge-moment coefficients and the floating characteristics of a control surface. Therefore, with proper aerodynamic

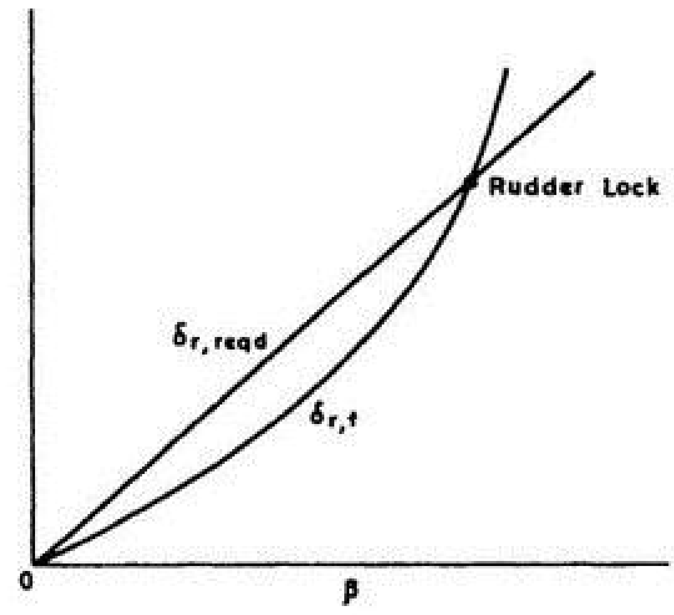

Fig. 3.89 Concept of rudder lock.

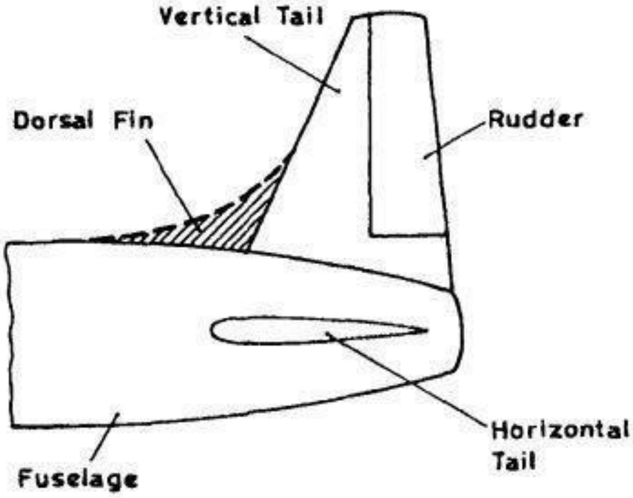

Fig. 3.90 Dorsal fin.

balancing, the floating tendency of the rudder can be so adjusted that the rudder lock phenomenon is avoided.

Dorsal fin use to prevent rudder lock. Another method of preventing rudder lock is the use of a device called a dorsal fin. As we know, the stall angle of a given lifting surface increases as the aspect ratio is reduced (see Chapter 1). Extending the chord of inboard sections adds area without extending the span so that the aspect ratio decreases. This form of extension is known as a dorsal fin as shown in Fig. 3.90. Addition of a suitably sized dorsal fin helps to delay the vertical tail stall to higher sideslip (Fig. 3.91a) and minimizes the possibility of rudder lock. Also, the dorsal fin makes the pedal forces vary monotonically with sideslip as indicated in Fig. 3.91b.

$$\delta_{rf} = -\frac{C_{h\beta}}{C_{h\delta r}}\beta$$