The delta wing is a special case of highly swept wing with extremely low aspect ratio. The design of delta wings was pioneered by Woolford in Germany and Cheranovsky in the Soviet Union prior to WWII. After the war, the tail-less delta became the favored design for high-speed aircraft design, and was used by Convair in the United States and Dassault in France.

The primary advantage of the delta wing design is similar to that of swept wings. The critical Mach number is delayed to a much higher value, and transonic / supersonic drag will be reduced.

Also, the delta wing’s planform carries across the entire aircraft, allowing it to be built much more strongly than a swept wing, where the spar meets the fuselage far in front of the center of gravity. In general, a delta wing will be stronger than a similar swept wing, and also having much more internal volume for fuel and other storage.
Subsonic Flows of Delta Wings

The delta wings at subsonic speed generate a pair of strong leading edge vortices as the angle of attack increases. This pair of vortices remains attached to the upper surface of the wing, giving the delta a very high stall angle of attack.

A normal wing built for high speed use (imagine, F-104) is typically dangerous at low speeds, but in this regime the delta changes over to a mode of lift based on the vortex it generates.

The disadvantages, especially marked in the older tailless delta designs, are a loss of total available lift caused by turning up the wing trailing edge or the control surfaces (as required to achieve a sufficient stability) and the high induced drag of this low-aspect ratio type of wing.
Delta Wing Vortices

The leading edge vortices are fairly steady over a wide range of angle of attack, supporting the lift force of the delta wing.

The surface pressure on the top surface of the delta wing is reduced near the leading edge and is higher and reasonably constant over the middle of the wing.

The spanwise pressure coefficient distribution is modified by the presence of strong vortices: this is the main mechanism of delta wings for enhances lift at high angles of attack.

Leading edge vortex flap (LEVF) further enhances the lift and increases $L/D$ over the flat delta wing.
Delta Wing Vortices: Flow Visualization

The delta wing leading edge vortices can easily be visualized in water tunnel. The streaklines can clearly be seen by injecting food coloring dye into the flow. This pair of strong counter-rotating vortices sustain in a wide variety of angles of attack in delta wings.
The Delta Wing (5)

Delta Wing Vortex Breakdown

Under a certain flow condition, the pair of leading edge vortices of delta wing starts to fluctuate and “burst.” This is called, the vortex breakdown. The vortex breakdown means the loss of lift (associated with stall condition during flight).

Some early delta wings tend to have this breakdown induce stall, associated with the deployment of wing trailing edge control surfaces flaps, for example). This caused many issues in stability and control of aircraft, and disadvantages especially in aerial combat maneuvering. One solution to fix this problem is to combine delta wings with canards.