A2 Magnetic Stray Fields

A2.1 Stray field low installation of cables

It was stated in chapter 4.2 that, by using a special installment technique for cables, the magnetic stray field around the cable can be considerably reduced. In order to completely compensate for the field, the return current has to flow along the same route as the forward current. This condition can only be approximately (in theory ideally) achieved by using a coaxial cable. However, this type of cable is not appropriate for use as a power supply cable due to heating reasons. A very good compromise can be achieved by use of a multi sector cable.

The approximation equations for four core arrangements (five core arrangements including the single core cable) are derived in this annex chapter. It is then shown that the sequence of phases has a decisive influence on the magnitude of the stray field being produced.

A2.1.1 The single core cable (case (a) of chapter 4.2)

By starting with Ampere’s law within Maxwell’s equations, the well-known relation for an infinitely long wire (Fig. A2.1) can be derived,

\[ H_\phi = \frac{I}{2 \cdot \pi \cdot r}. \]  

(A2.1)

Fig. A2.1 Magnetic field around a single core conductor

The assignment of the field vector direction from the current direction is determined by the right screw rule.

**A2.1.2 Cable with one forward and one return conductor (case (b) of chapter 4.2)**

![Diagram of a two-conductor cable](image)

Fig. A2.2 Magnetic field of a two conductor cable

*Auxiliary calculation:*

\[
\frac{1}{1 + \varepsilon} \approx 1 - \varepsilon
\]

\[
\sqrt{1 + \varepsilon} \approx 1 + \frac{\varepsilon}{2}
\]

\(\varepsilon\) represents a very small value

\[
(1 + \varepsilon)^2 \approx 1 + 2\varepsilon
\]

\[
(1 + \varepsilon)^3 \approx 1 + 3\varepsilon
\]

\[
\sin \varepsilon \approx \varepsilon - \frac{\varepsilon^3}{3!}
\]

\[
H(R) = \frac{I}{2 \cdot \pi \cdot \left( R - \frac{d}{2} \right)} - \frac{I}{2 \cdot \pi \cdot \left( R + \frac{d}{2} \right)}
\]

\[
= \frac{I}{2 \cdot \pi \cdot R \left( 1 - \frac{d}{2R} \right)} - \frac{I}{2 \cdot \pi \cdot R \left( 1 + \frac{d}{2R} \right)} = \frac{I}{2 \cdot \pi \cdot R} \left( \frac{1}{1 - \frac{d}{2R}} - \frac{1}{1 + \frac{d}{2R}} \right)
\]

\[
\approx \frac{I}{2 \cdot \pi \cdot R} \left( 1 + \frac{d}{2R} - 1 + \frac{d}{2R} \right)
\]