Ericsson Microwave Outlook

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Tackling the sunflower effect

A small temperature difference across a tower can create challenges for narrow beam microwave links. Learn why the sunflower effect matters and how to tackle it.

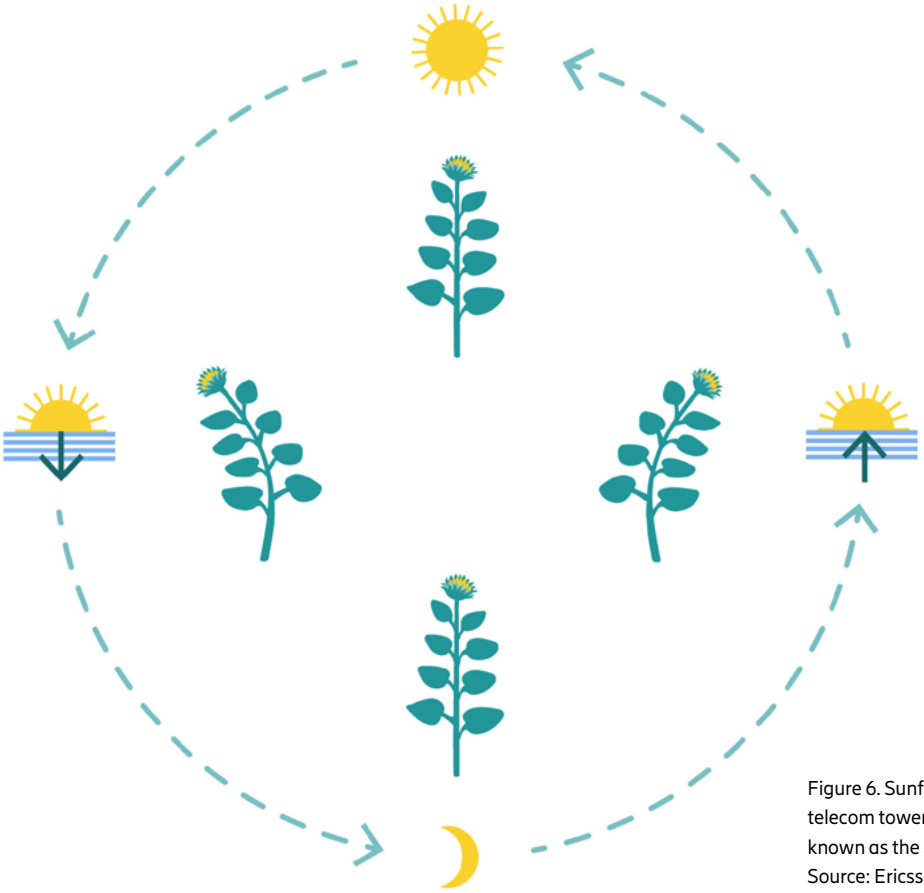


Figure 6. Sunflowers bend toward the sun while telecom towers bend away from the sun. This is known as the sunflower effect.
Source: Ericsson (2026)

For Communication Service Providers (CSPs) deploying E-band links, small tower movements can have a significant impact. A narrow beam that shifts by fractions of a degree can lose signal strength, reduce fade margin, and interrupt services. One cause is the sunflower effect. Understanding and managing this effect is particularly important for high-capacity microwave links that depend on precise antenna alignment.

The sunflower effect starts when sunlight heats one side of a tower. The warmer side expands, the tower bends away from the sun, and the antenna points slightly off target. For narrow E-band beams, that small movement can be enough to affect performance.

Towers are designed to remain stable under heavy loads and harsh weather conditions, but no material is immune to temperature changes. When one side expands more than the other, alignment can shift. Table 1 shows thermal expansion values for different materials.

Uniform heating rarely creates problems. The risk arises when one side of the tower is warmer than the other, especially in direct sunlight. The hot side expands more than the cold side, creating strain and a slight tilt.

Material	α [10^{-6}/°C]
Cast iron	10.4-11
Steel	10.8-12.5
Concrete	13-14
Aluminum	21-24

Table 1. Thermal expansion constant, α for different materials.

Estimate how much the tower moves
To understand when the sunflower effect becomes operationally significant, it helps to estimate how much tower movement a given temperature difference can cause.

To estimate this, the tower may be divided into small segments, each with height **x**, When the sun warms one side of a segment, each segment expands by **Δx** (see Figure 7), calculated as:

$$\Delta x = x\alpha\Delta T$$

Equation 1

Here, **ΔT** is the temperature difference between the two sides of the segment. For each segment the expansion on the warmer side causes an angular tilt, **φ**.

If **D** is the tower diameter, **φ** can be calculated as:

$$\varphi = \tan^{-1}\frac{\Delta x}{D}$$

Equation 2

A tower with height **h**, may be divided into **n** small segments, each with height **x**. The total tower tilt **θ** at the top is the sum of the angular tilt **φ** across all segments. As the segments get smaller and **n** approaches infinity, the aggregate tilt in radians can be calculated using Equation 3, giving the aggregate tower tilt **θ** in radians. Figure 7 shows how the tower will bend away from the sun in a curve.

$$\theta = \frac{h\alpha\Delta T}{D}$$

Equation 3

Using Equation 3 we can see that a 35 m steel monopole with a 0.6 m diameter, and a 10°C temperature difference can create a top-of-tower tilt of 0.40°. In many E-band deployments, that is enough to misalign the antenna and degrade performance.

Example 1

Measure tower movement without climbing
Tilts due to sunflower effect are small and can fall below the resolution of standard gyroscope tools, while climbing the tower to install measurement equipment is often impractical and costly. A commercial laser distance meter gives field teams a simpler option: measuring and logging horizontal movement at the top of the tower from the ground.

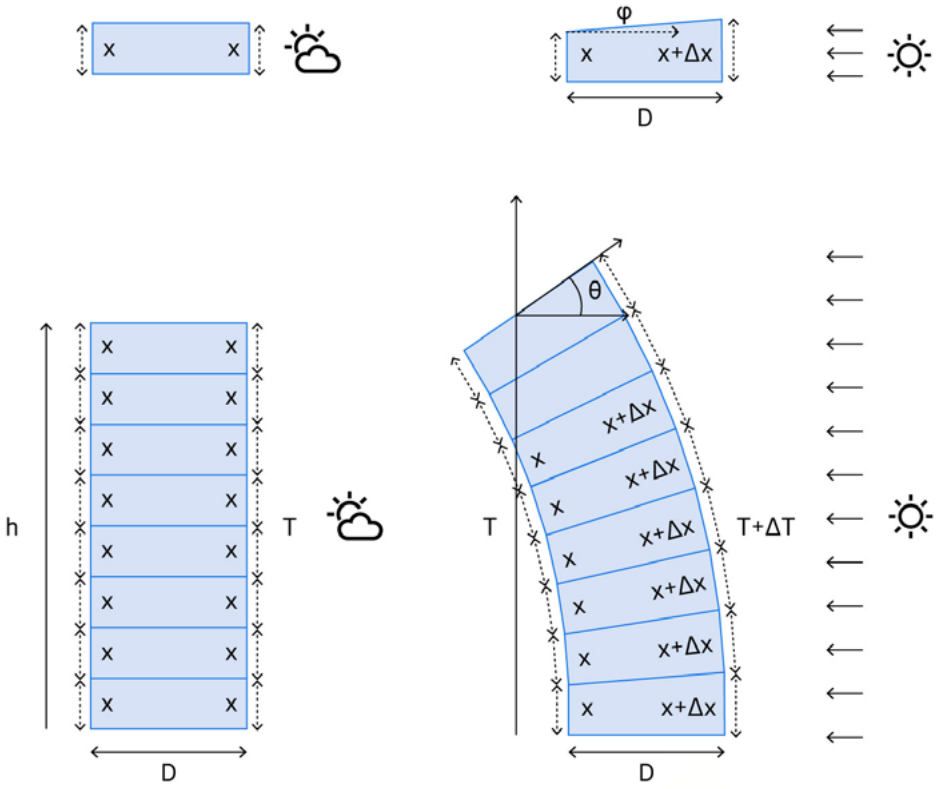


Figure 7. Aggregated tilt, **θ** of the tower when exposed to heat. A material exposed to heat will expand in length.
Source: Ericsson (2026)

Using a distance meter, we measure a deviation **ΔZ** from the centerline. Using the same model as above, based on segmentation we can estimate the deviation as the sum of movement across all segments. Equation 4 gives the closed-form expression.

$$\Delta Z = \frac{\alpha\Delta T h^2}{2D}$$

Equation 4

Combining Equation 3 and Equation 4 give the tower tilt **θ** in radians as a function of the measured tower deviation **ΔZ**.

$$\theta = \frac{2\Delta Z}{h}$$

Equation 5

To assess the sunflower effects on installed telecom equipment in a 35 m high steel tower, a service engineer places a laser distance meter on the ground near the site and records top-of-tower movement for 24 hours. The next day, the logs show a maximum movement of 13.8 cm. Using Equation 5, this corresponds to a maximum tilt of 0.45°.

Example 2

A common mistake is to treat tower movement as a straight-line tilt from the base to top. The tower bends in a curve, as shown in Figure 7. The straight-line approximation underestimates the actual tilt by a factor of two.

CSPs do not always need dedicated measurement equipment to identify sunflower effects. Long-term performance analytics from the live microwave link can reveal recurring alignment changes and help estimate their impact on network performance. Figure 8 (bottom) shows attenuation measured over one week on an E-band link installed on a 22 m steel monopole. The daily pattern, shown in detail in the top panel, is consistent with solar heating of the tower. As one side of the pole warms, the antenna moves off alignment, and attenuation increases. Comparing the measured attenuation with the antenna pattern indicates a maximum tilt of approximately 0.8°. For a monopole with a diameter of 30 cm, this corresponds to a temperature difference between front and back of about 16°C.

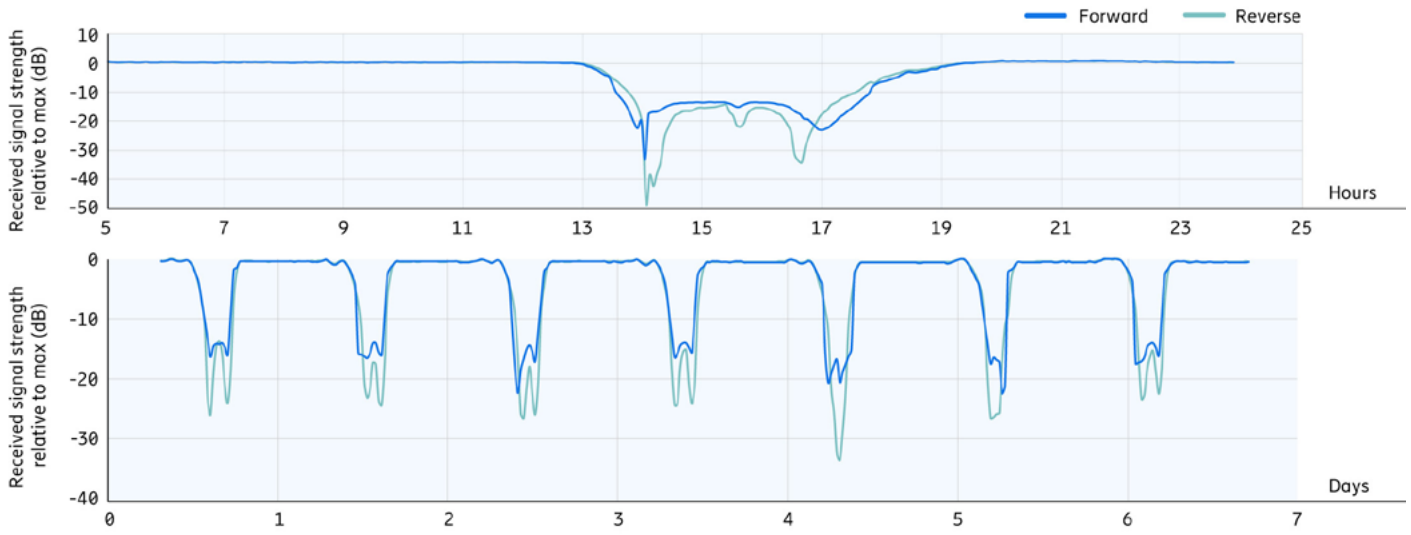


Figure 8. Measured long-term attenuation over a week for an E-band monopole installation with 0.6 m antenna (bottom). Measured attenuation over 24 hours (top). Source: Ericsson (2026)

Why sunflower effects matter for E-band links

E-band links deliver very high capacity using narrow, highly directional beams. That makes them particularly sensitive to tower movement. Even small changes in antenna alignment can reduce received power, shrink fade margin, and affect service availability.

A 0.6m E-band antenna can deliver more than 50 dBi of gain, but its half-power beamwidth is only 0.38°. A tilt of 0.19° can cut received power by 3 dB, and a 0.35° misalignment can reduce antenna gain by more than 10 dB. With 0.6 m and larger E-band antennas, tower stability becomes part of the link budget, not a site detail.

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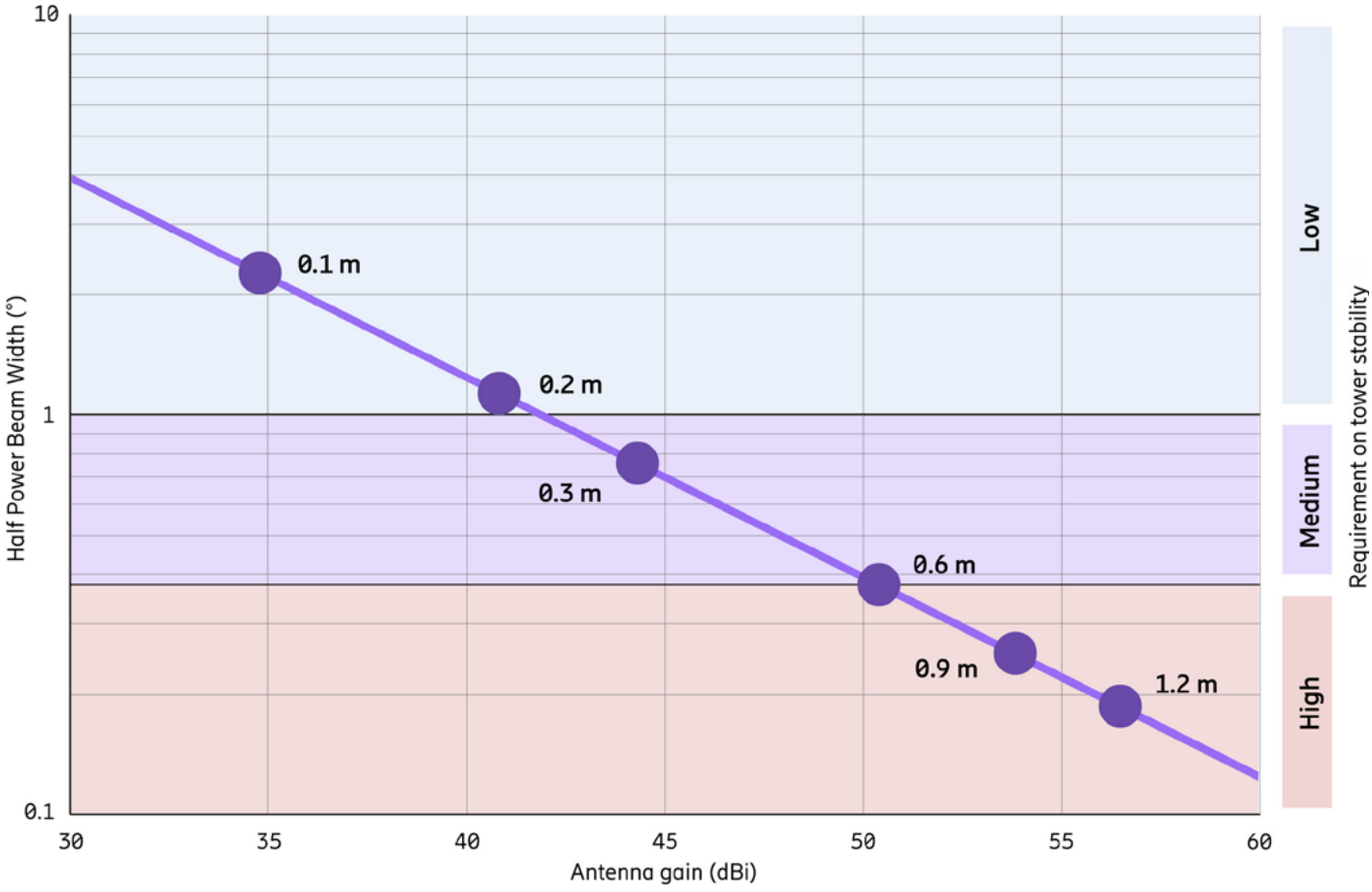


Figure 9. Half Power Beam Width versus antenna gain for different diameters of E-band reflector antennas. Source: Ericsson (2026)

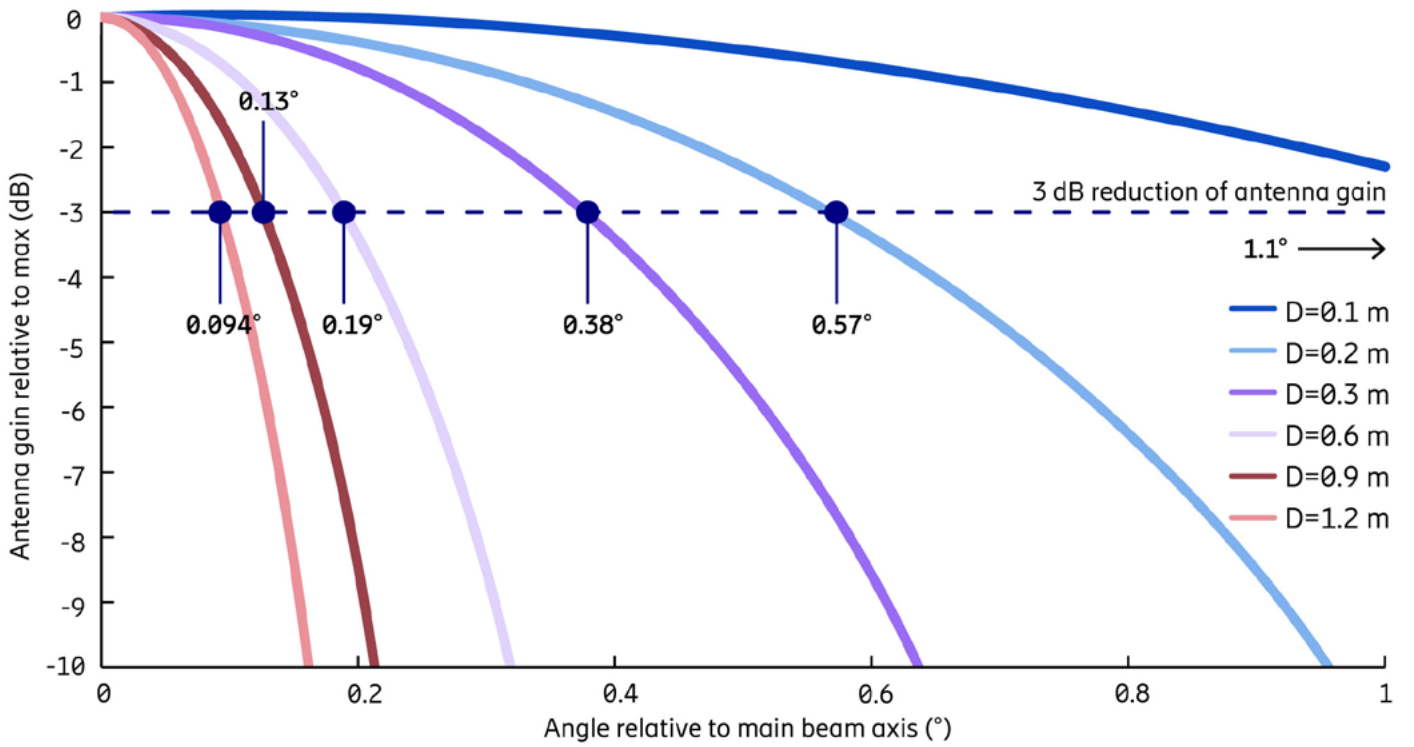


Figure 10. Relative E-band antenna gain versus misalignment for 0.1 m, 0.2 m, 0.3 m, 0.6 m, 0.9 m, and 1.2 m diameter antennas. Source: Ericsson (2026)

Tower bending caused by the sunflower effect is proportional to the temperature difference between the hot and cold sides of the tower. If the temperature difference increases from 10°C to 20°C, the misalignment doubles from 0.44° to 0.88°. This can sharply reduce antenna gain and, in some cases, cause a link outage.

Reduce the impact on live links

CSPs have two main choices: reduce how much the tower moves, or keep the antenna aligned as the tower moves. The right approach depends on the site, the link budget, and how much variation the service can tolerate.

Equation 3 shows that angular tilt is proportional to installation height. Placing the antenna halfway down the tower cuts the tilt by about 50 percent. A larger tower diameter also reduces tilt. Because the sunflower effect depends on the temperature difference across the structure, it is less common in lattice towers and more common in monopole installations.

When site conditions cannot be changed, the radio link can compensate for tower movement. One option is a sway-compensation antenna that can correct mast movement of ±2° or more. A common implementation steers the feeder inside the antenna. This supports both sunflower effect tilt and wind-induced sway. The trade-off is that antenna gain can still vary because efficiency decreases as the feeder angle changes.

Another option is an electrically steerable antenna fixture that continuously realigns the antenna as tower tilt changes. This can support larger angular deviations, and one fixture can match different radio and antenna combinations. The trade-offs are response speed and mechanical exposure. The combined radio and antenna mass makes fast wind-sway correction difficult, and the mechanical installation can be more vulnerable to wind, snow, and ice.

As microwave transport carries more capacity over narrower beams, tower movement becomes a network performance issue. By combining field insight, link analytics, and alignment compensation, CSPs can protect fading margins and keep services available. The microwave industry continues to develop microwave transport solutions that help CSPs maintain alignment, protect link performance, and maximize network availability under all types of challenging environmental conditions.

Placing the antenna halfway down the tower cuts the tilt by about

50%

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