

Lead Crowning vs. Unmodified Tooth Flanks

Two gear contact configurations are compared under the same nominal operating conditions, without shaft misalignment. Their maximum contact pressures are of similar magnitude, but their locations along the tooth face differ substantially.

01 / With lead crowning — contact pressure field

Longitudinal crowning concentrates the highest contact pressures toward the central region of the tooth face. The original numerical results below show the 3D pressure field, transverse and longitudinal pressure distributions, and the calculated contact area.

Original numerical results · Crowned gear contact.

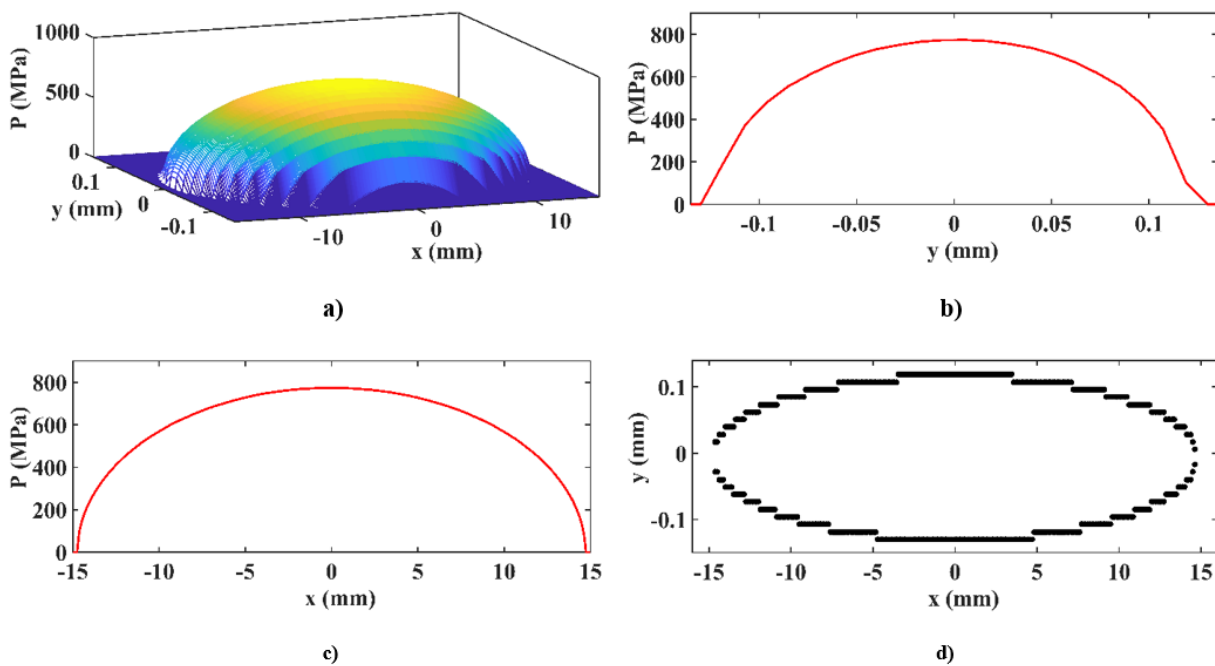
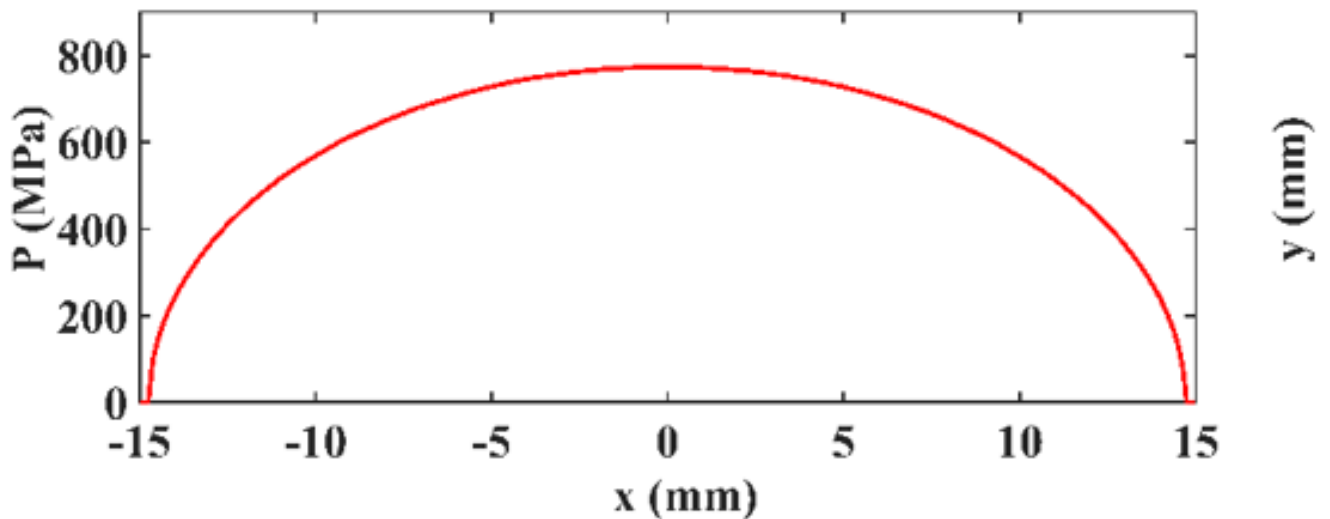


Fig. 4.40 a): Distribuția spațială a presiunilor de contact, vederea transversală și longitudinală și aria de contact reală în cazul profilului cu bombament

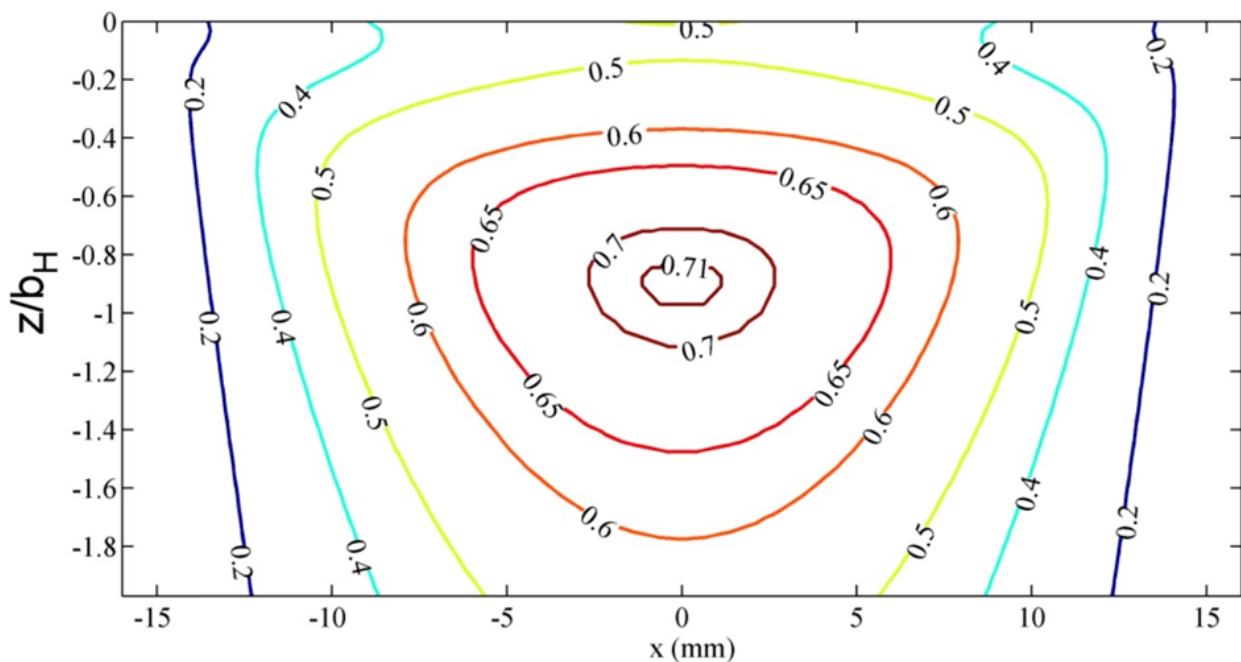
02 / Longitudinal pressure distribution

Along the face width, the pressure distribution is smoothly reduced toward both tooth ends. This shift in the location of the pressure maximum is the central benefit illustrated by this case.



03 / Subsurface von Mises stress

The subsurface equivalent-stress field complements the contact-pressure results. It helps examine the internal stress distribution, rather than assessing the contact only by its peak surface pressure.



04 / Without lead crowning — contact pressure field

In the unmodified configuration, pressure peaks appear near the tooth ends. Although the maximum pressure is of a comparable order of magnitude, its location introduces a less favorable edge-contact condition.

Original numerical results · Uncrowned gear contact.

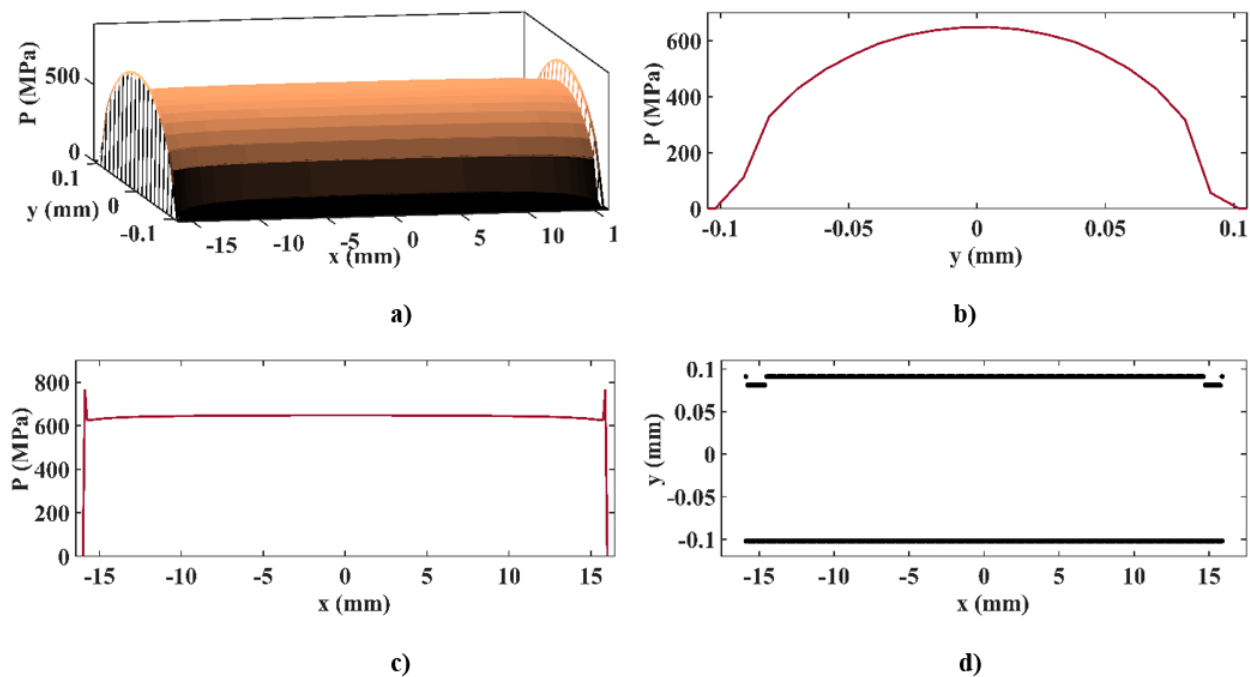


Fig. 4.41: Distribuția spațială a presiunilor de contact, vederea transversală și longitudinală și aria de contact reală în cazul în care modificarea de profil nu s-ar fi realizat

Engineering conclusion

Engineering conclusion: Peak contact pressure alone does not fully describe the quality of a gear contact pattern. In this comparison, the crowned and unmodified tooth flanks develop maximum pressures of a similar magnitude, yet the critical pressure zones are located in markedly different regions of the tooth face. Without crowning, localized peaks appear near the face-width boundaries, where contact termination and edge effects can intensify local loading. The resulting concentration is particularly undesirable because small changes in operating conditions or component deformation may further accentuate edge loading. With longitudinal crowning, the pressure field becomes more centrally located and decreases toward the tooth ends. The modification therefore does not simply aim to lower a single peak value; it shapes the load distribution and reduces the involvement of the tooth edges in carrying the highest contact pressure. The engineering lesson is that microgeometry should be assessed through the complete pressure field, including the position of its maxima and the extent of the contact area—not by one maximum-pressure number in isolation. This result is specific to the aligned, nominal-load configuration studied here; the optimum crowning amount and its benefits under misalignment or other operating conditions require separate evaluation.