SWAB PRESSURE DUE TO CONE POP-OUT

Predicting swab pressure resulting from cone pop-out due to tubular expansion during mono-diameter well drilling

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WHAT IS MONO DIAMETER DRILLING?

OBJECTIVE AND RESULTS

Main objective

"What is the magnitude of swab pressure due to cone pop-out and how is it influenced?"

Results

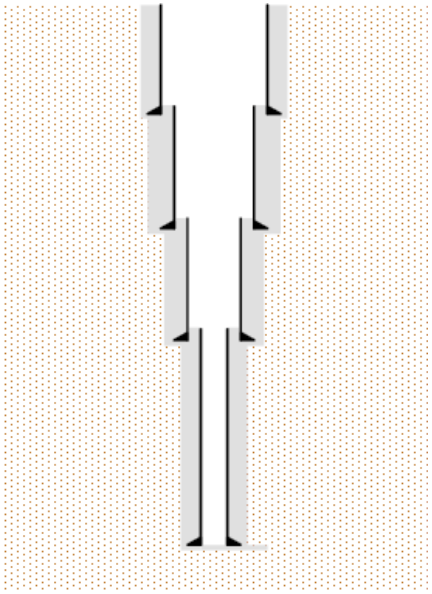
- Two numerical programs are made that can predict swab pressures
- Sensitivity analysis for various parameters has been done

BACKGROUND & APPROACH

Mono diameter drilling
Cone pop-out
Approach
Application

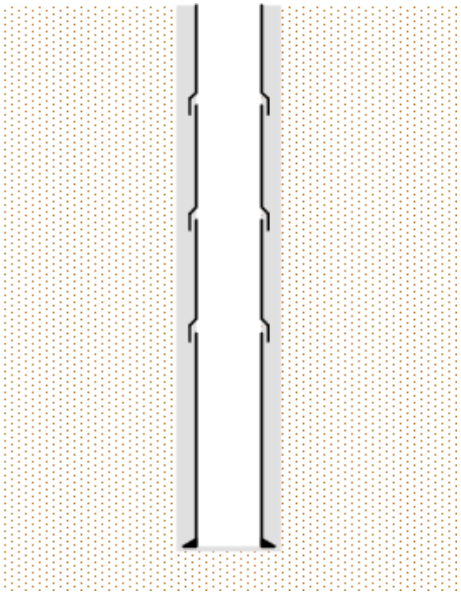
MONO DIAMETER DRILLING

Conventional drilling



- More material needed
- Larger drilling rig
- Telescopic well design

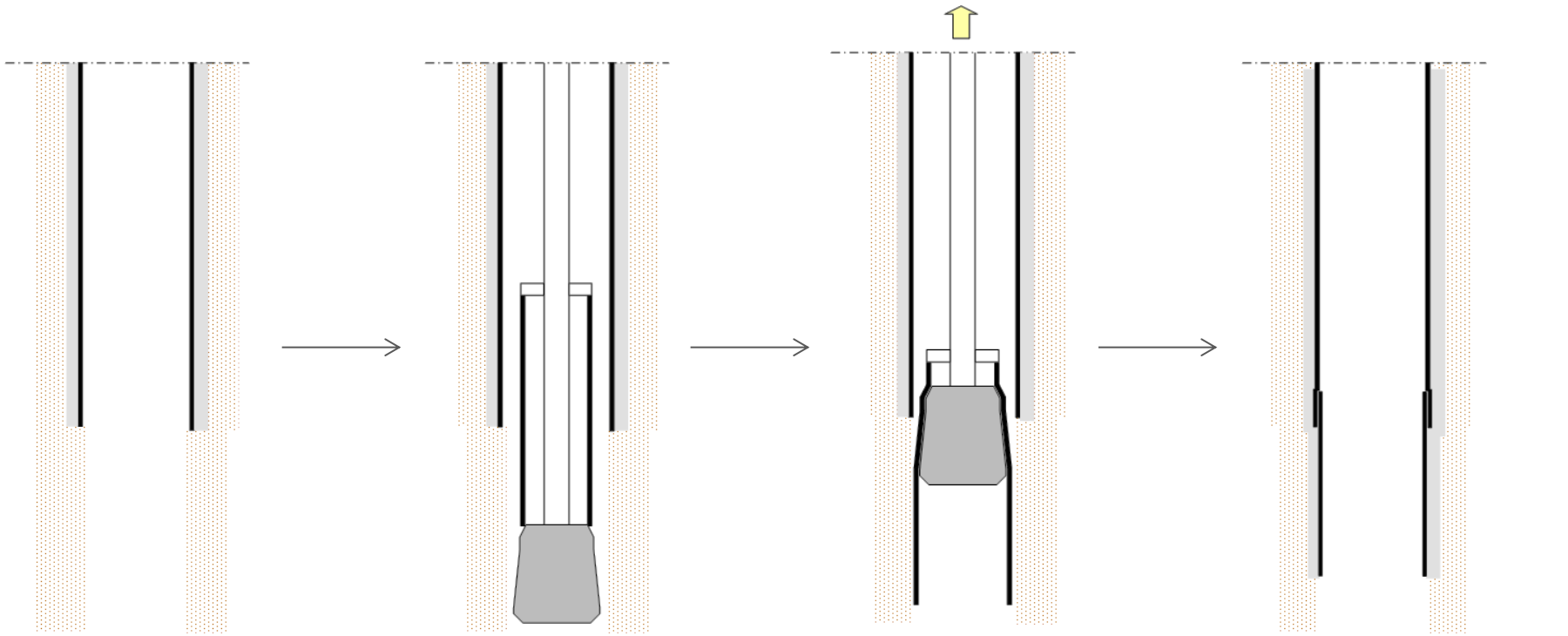
Mono diameter drilling



- Less material needed
- Smaller drilling rig
- Slim well-design

MONO DIAMETER DRILLING

Pipe expansion



Well filled with drilling mud

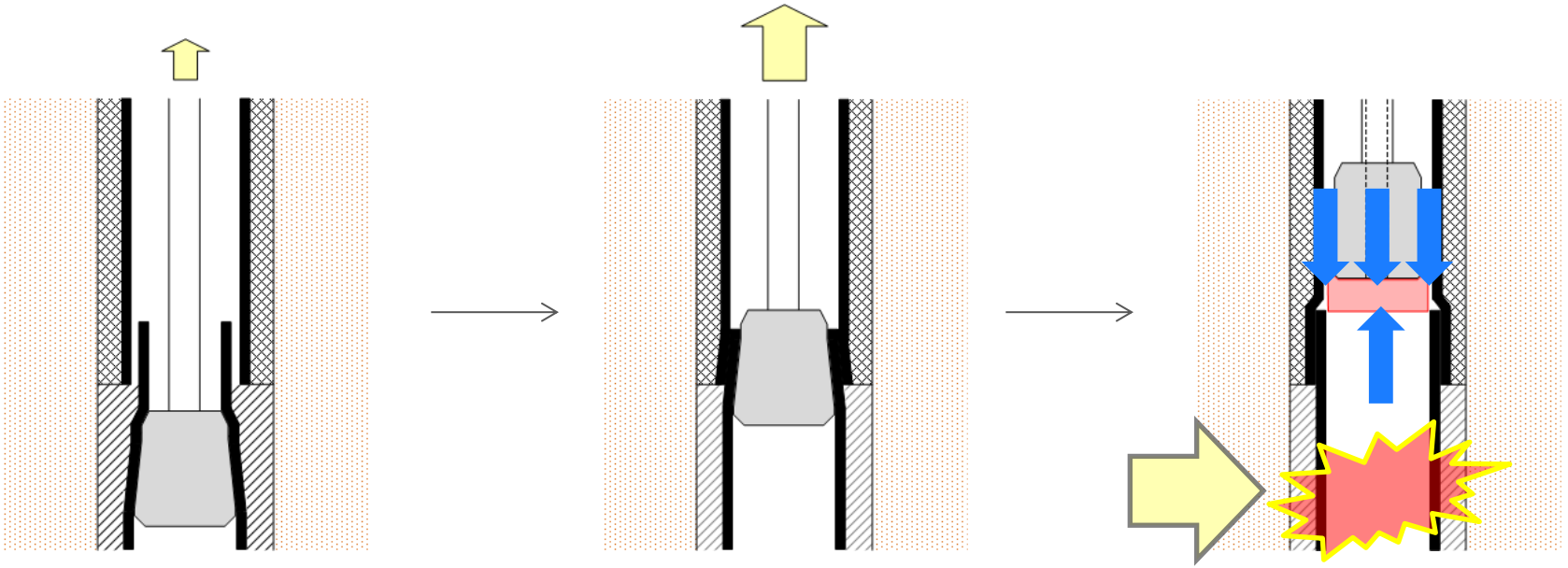
Smaller pipe inserted with cone

Cone pulled and expanding pipe

Result design well with minimal diameter reduction

CONE POP-OUT

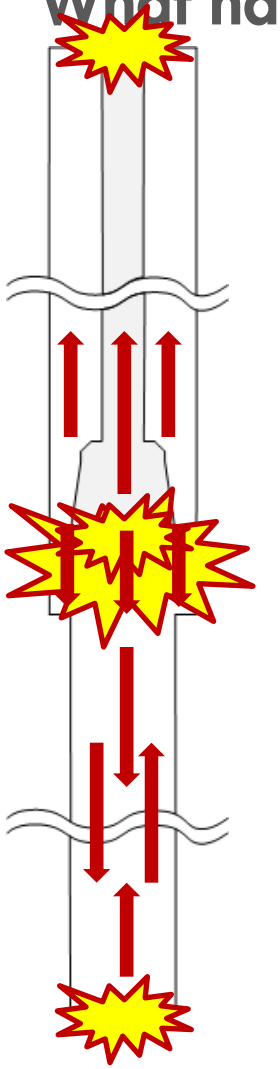
Close up of pipe expansion



- Cone reaches overlap
- Additional expansion force
- Drill string stretches
- After expansion, energy released in form of acceleration cone
- Void below the cone

CONE POP-OUT

What happens after a cone pop-out?

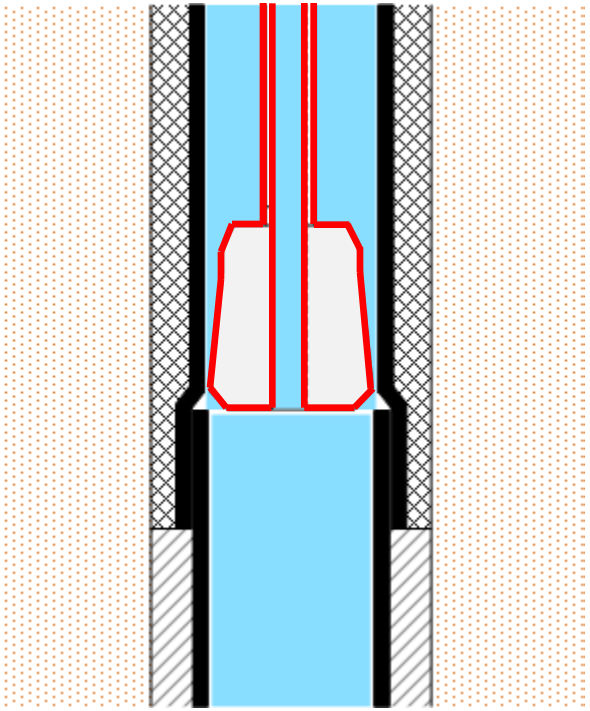


- Cone pops out and wave starts running through drill string
- Cone pushes fluid above generating a (positive) pressure wave
- Fluid bottom hole is expanded creating negative pressure wave
- Negative pressure wave reflects at the bottom, doubling amplitude
- Negative pressure wave reaches cone and (partially) reflects
- Cycle continues…
- …until wave in drill string hits surface and cone stops
- Fluid in bottom hole is contracting, increasing pressure

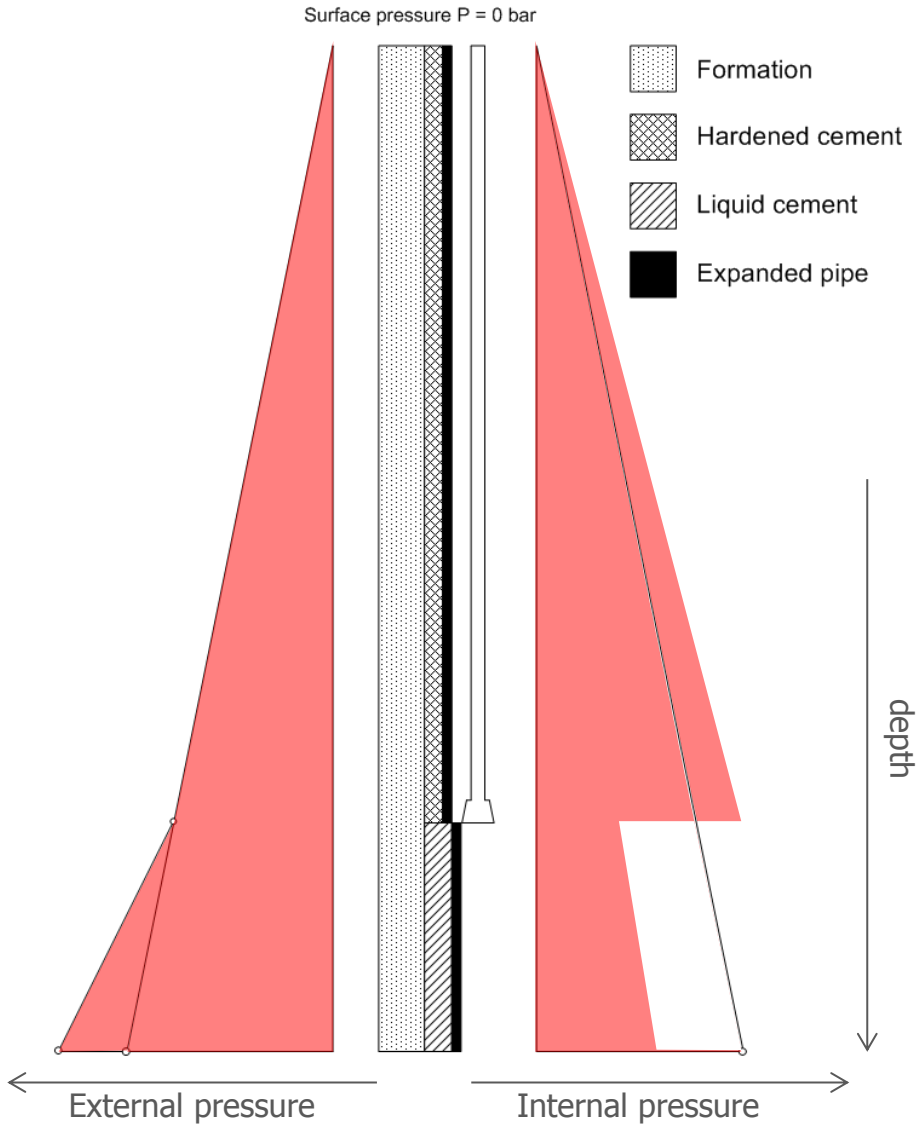
Approach of investigation swab pressure

Divide system in two components

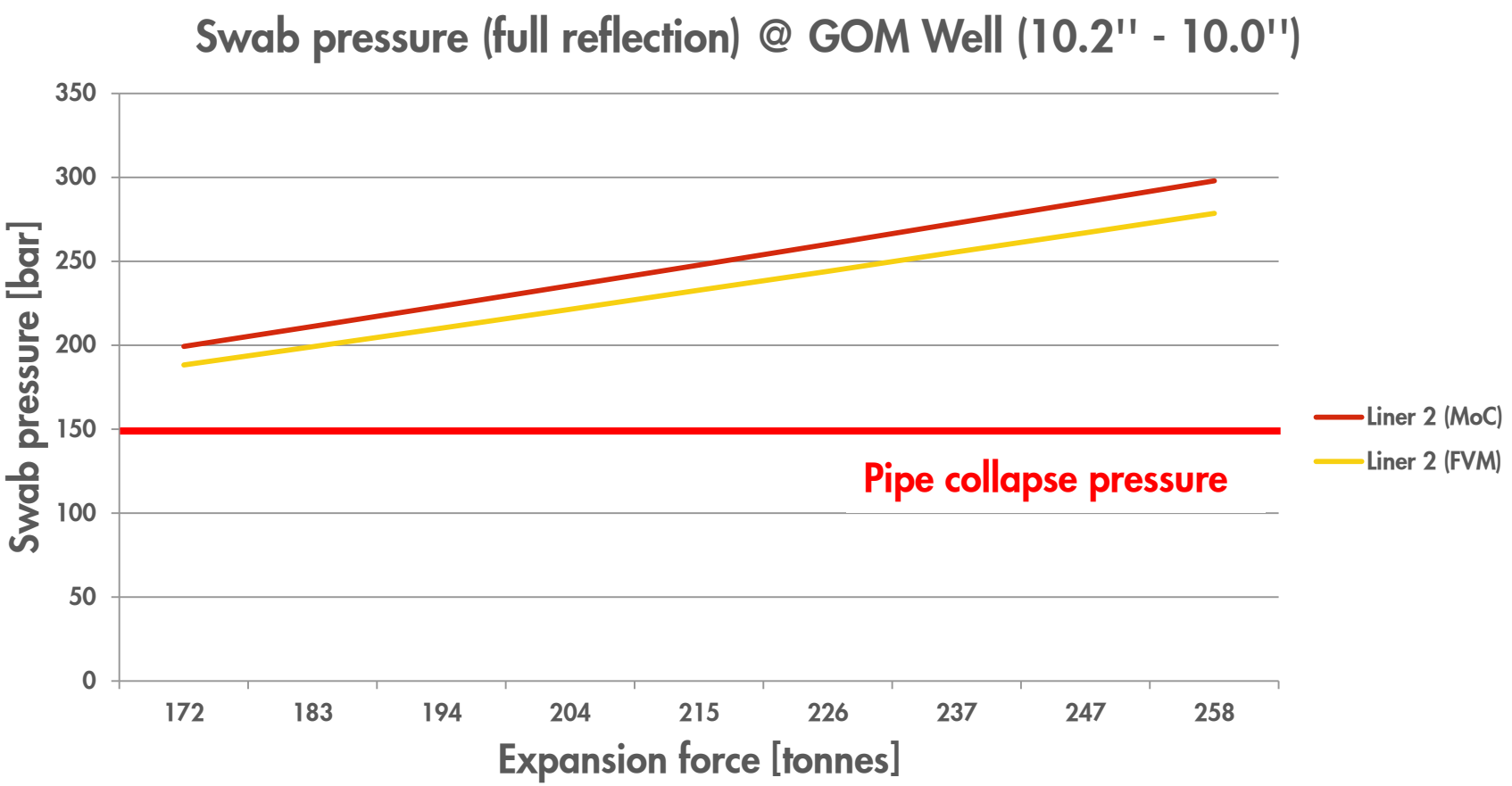
- **Structure**
  - Longitudinal motion of drill string + cone
  - Drill string is stretched due to expansion force
  - Longitudinal motion of slender rod with mass at tip due to initial displacement
- **Fluid**
  - Three regions
    1. Bottom hole
    2. Annulus
    3. Inner drill string
  - Transient fluid flow analysis
- **Interaction**
  - Fluid pressure
  - Frictional losses (minor & major)



APPLICATION – EXTERNAL PRESSURES



EXPANSION FORCE VS SWAB PRESSURE (10.2 – 10.0)



CONCLUSION

Conclusion
Recommendations

CONCLUSION

Conclusion

- Swab pressure due to cone pop-out is a significant risk for pipe collapse and should be taken into account
- Clearance, expansion force, bottom hole reflection are most sensitive
- Models used on well in Gulf Of Mexico

Recommendations

- Experimental validation is needed
- Measure fluid pressure during pipe expansions in the field to use data
- Investigate in reflective properties bottom hole