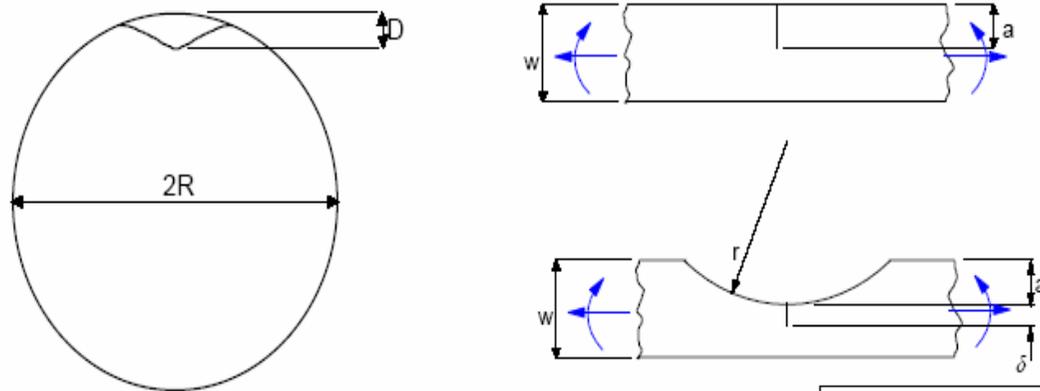


Supplements to PD 8010 and IGEM – Factors which Influence Failure due to 3rd Party Interference

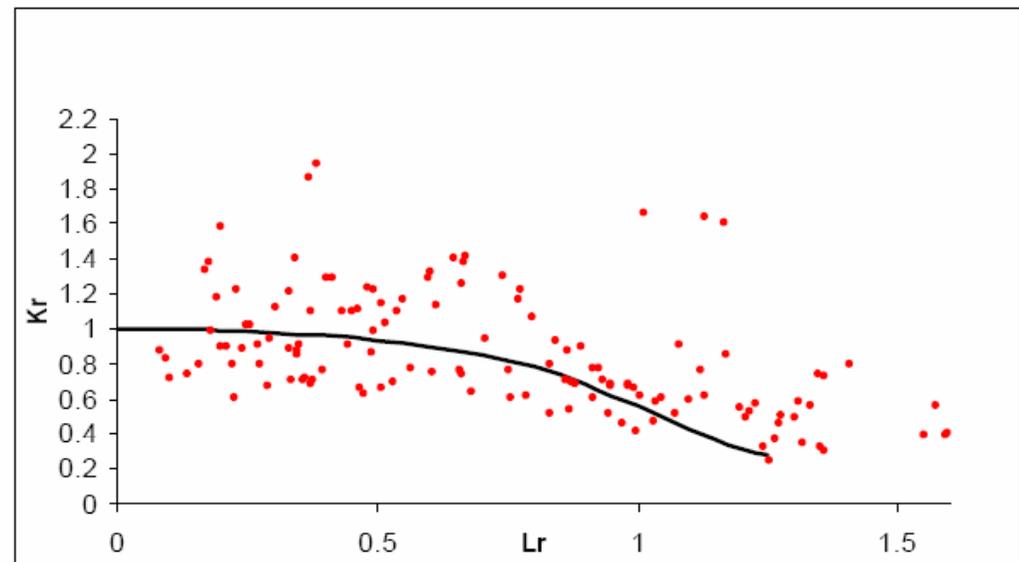
UKOPA/05/00xx

Development of Risk Reduction Factors for 3rd Party Interference

UKOPA mechanical damage limit state model:-



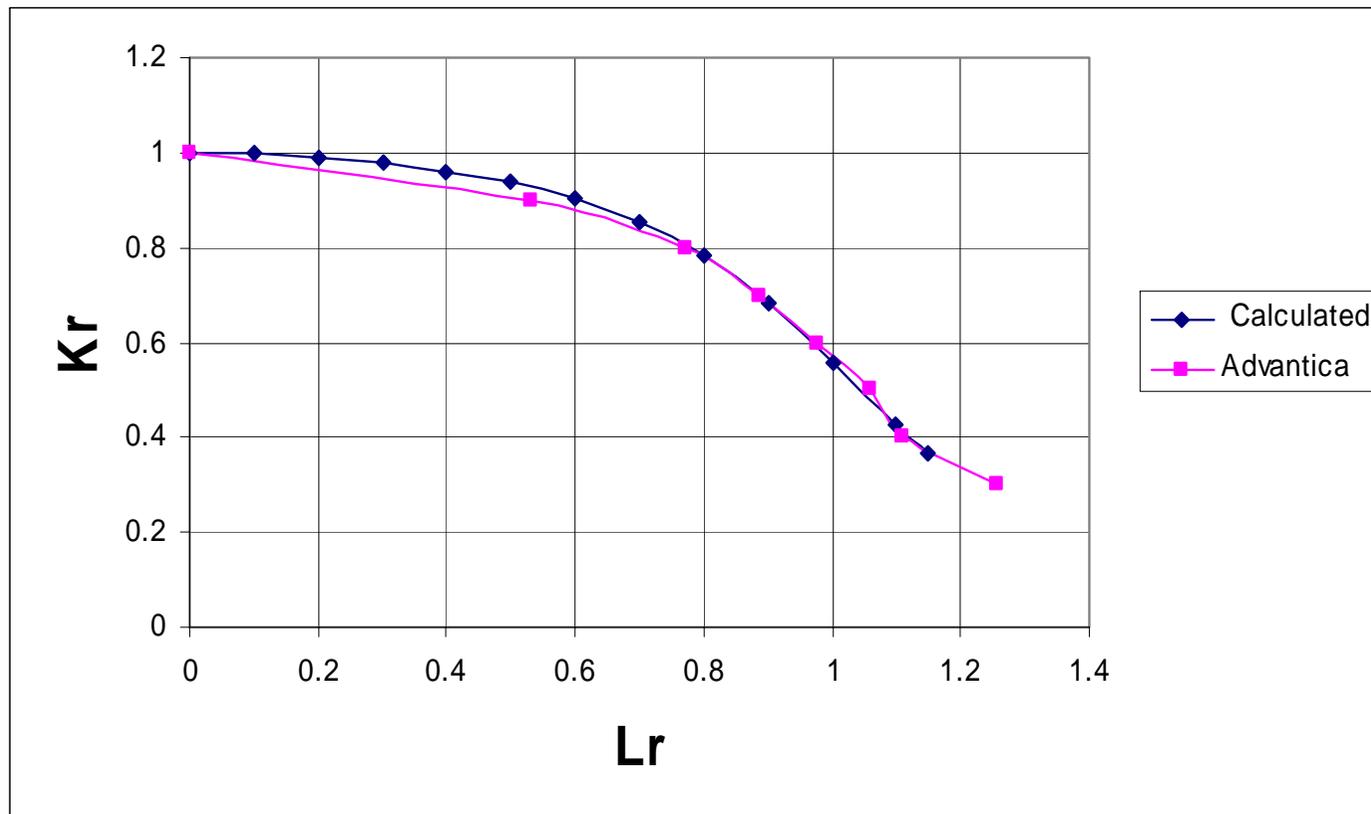
$$K_r \geq F(S_r)$$



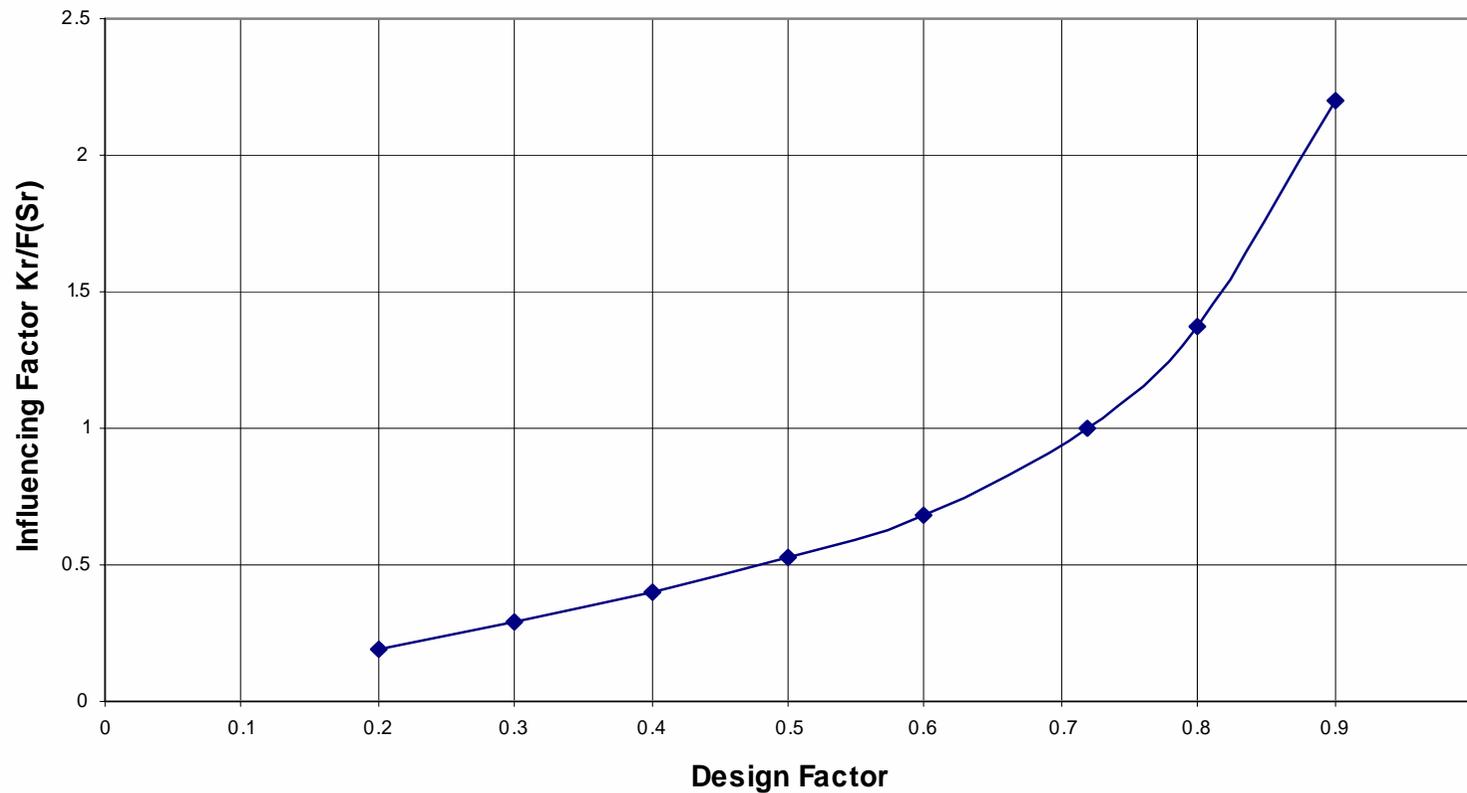
The UKOPA Mechanical Damage Limit State Model

- Standard deterministic failure model
- Independent of pipeline failure frequency data
- Can be used to study the influence of various parameters on pipeline failure
- Has been used to carry out studies to quantify the influences on pipe failure due to 3rd party damage
- Results can be applied as factors on failure frequency due to 3rd party damage

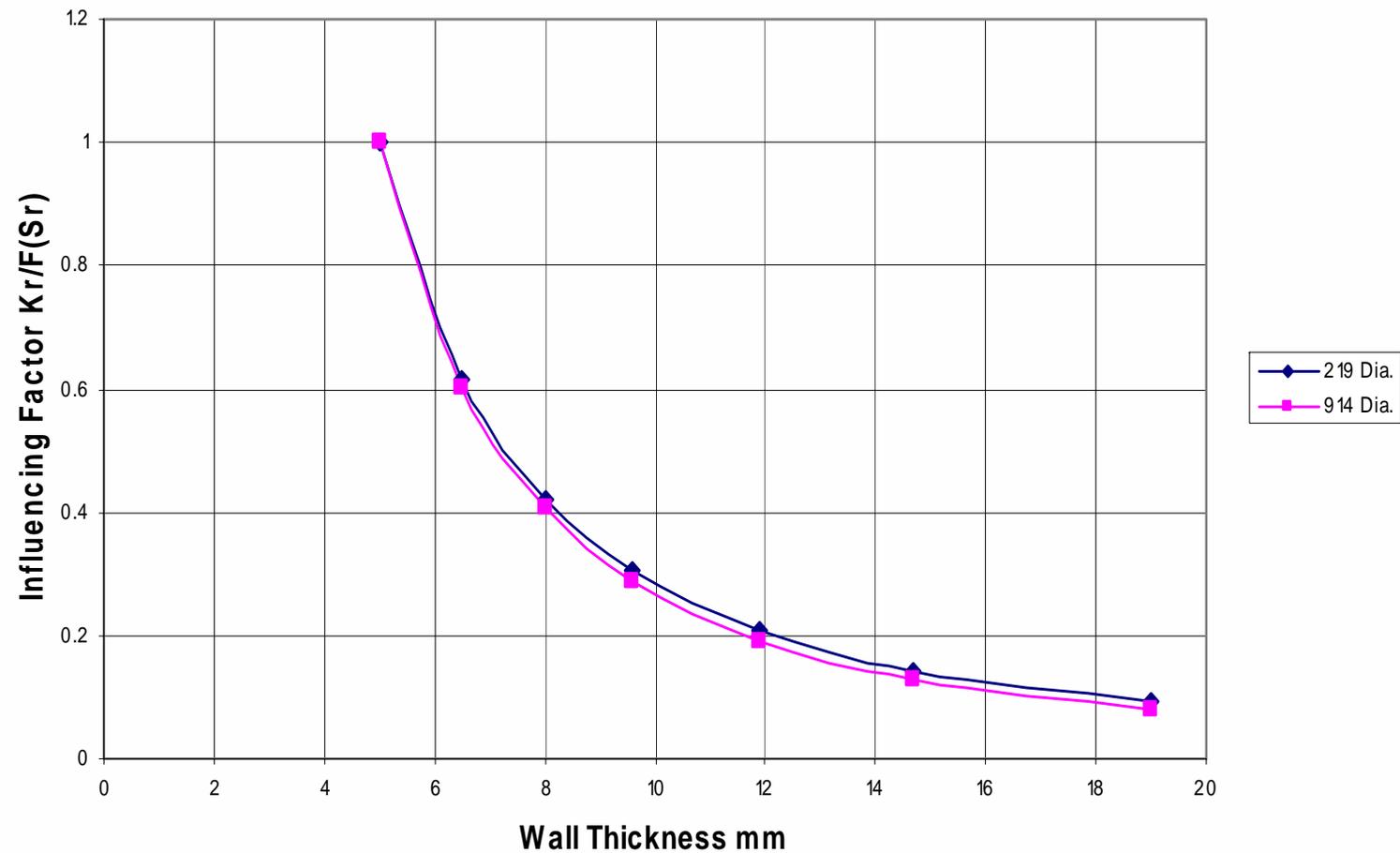
Comparison of Calculated Limit State Function with Advantica



Influence of Design Factor



Influence of Wall Thickness

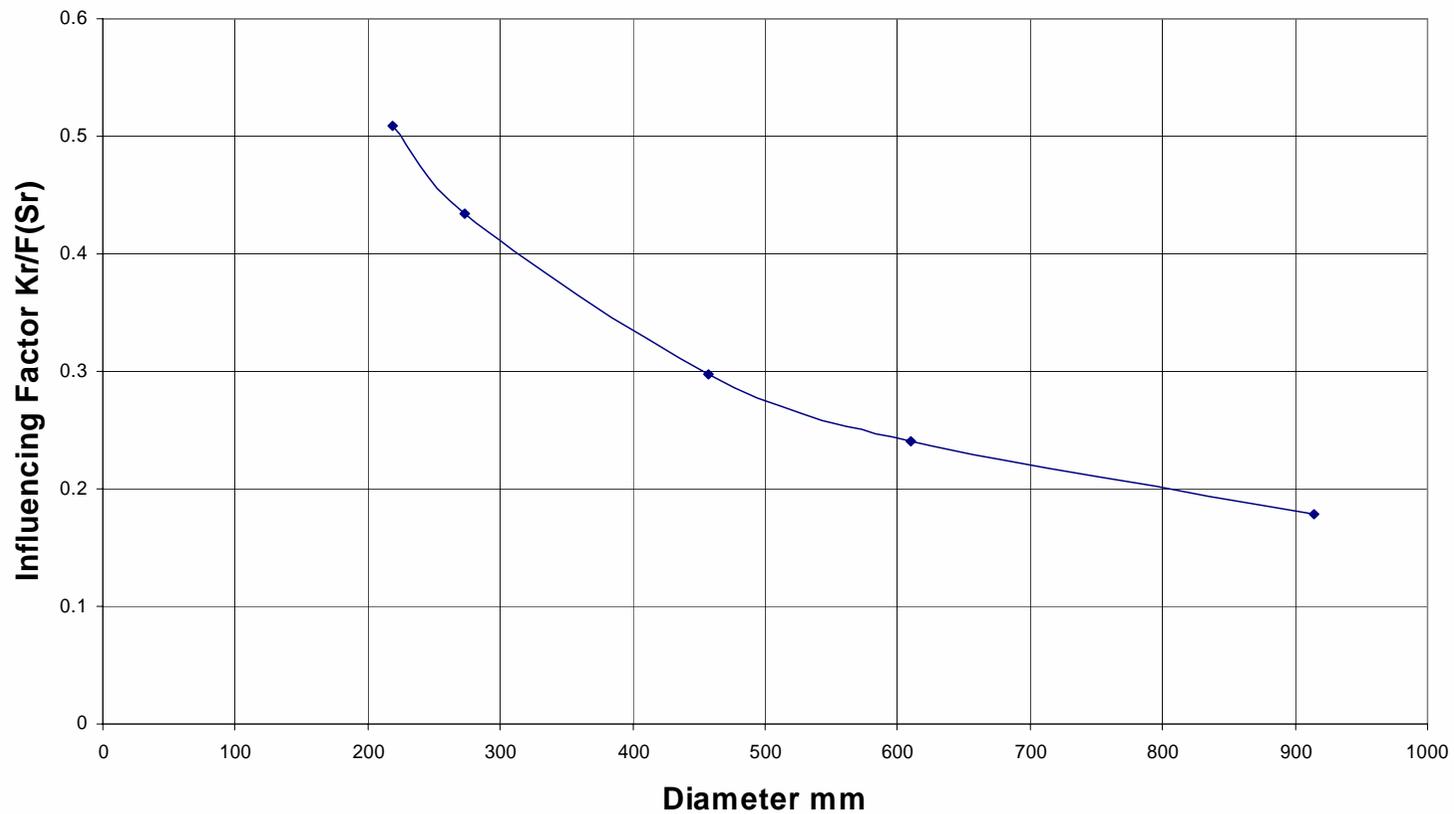


Influence of Material Properties

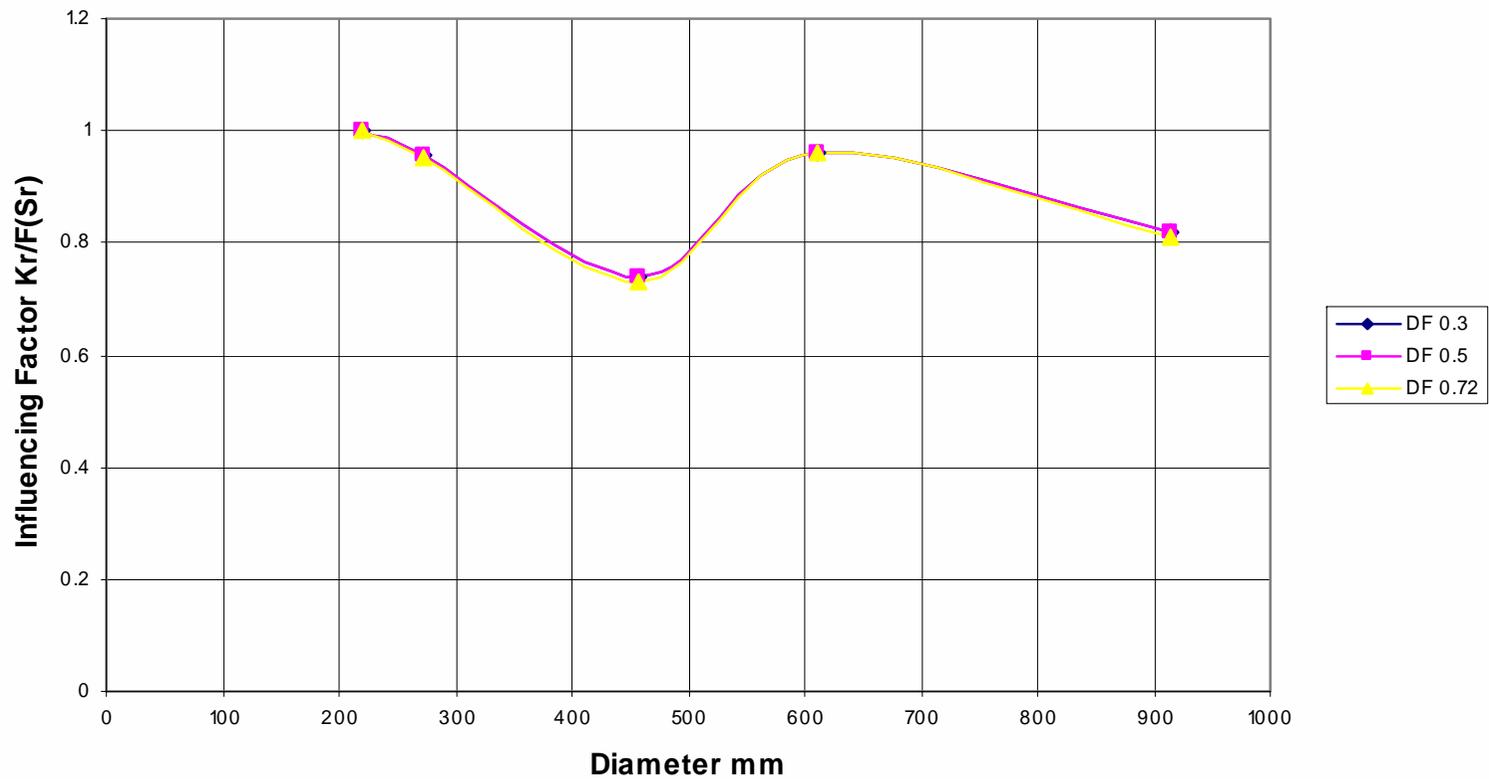
- Changes in material properties do not affect design factor or geometric trends
- Variations in dent and gouge parameters modify location but do not affect the trend of the reduction factor

Influence of Diameter

(Wall Thickness constant)

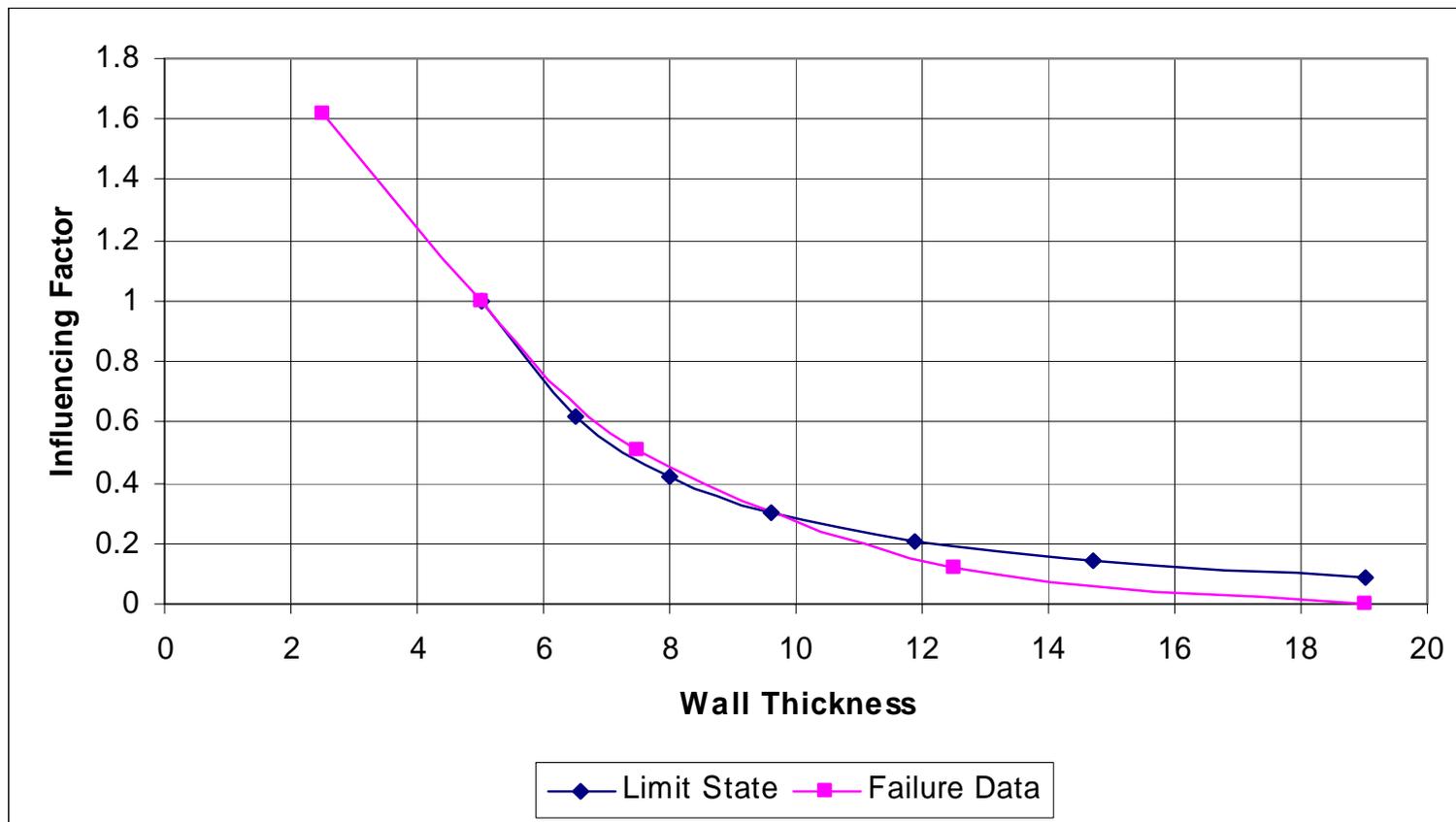


Influence of Diameter (Wall thickness varies)



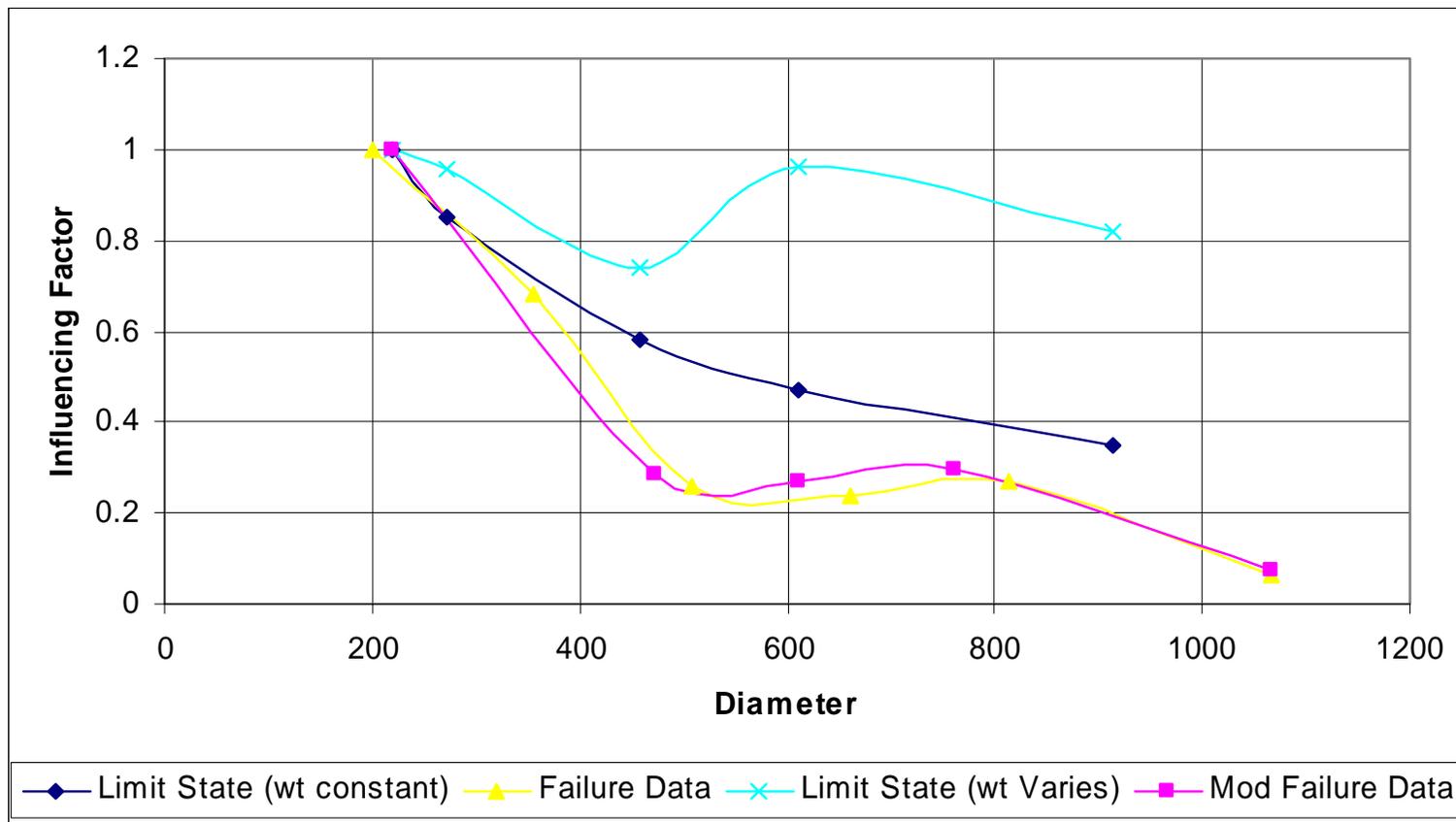
Comparison with UKOPA Failure Data

Effect of Wall Thickness

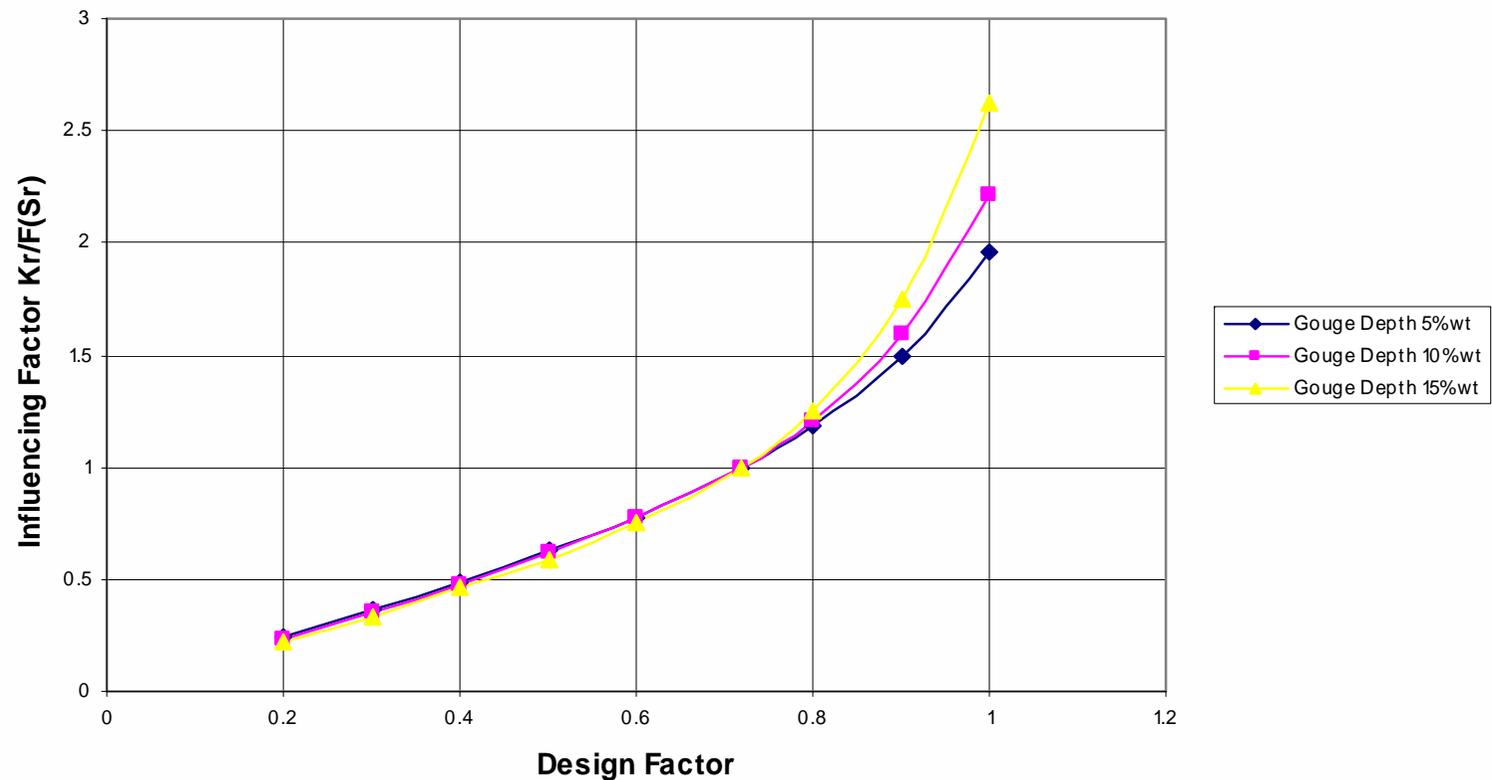


Comparison with UKOPA Failure Data

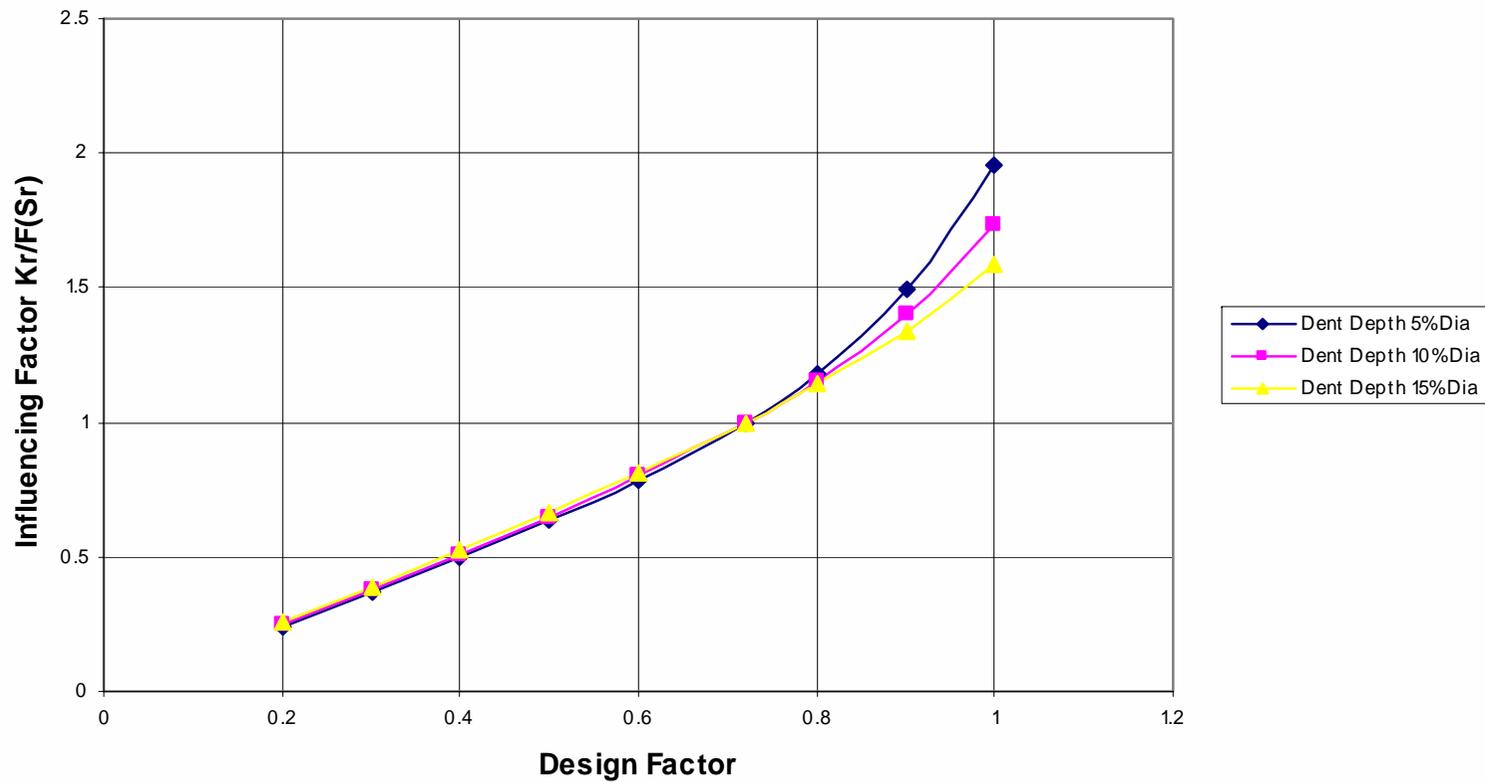
Effect of Diameter



Influence of Gouge Depth



Influence of Dent Depth



Influences on Failure Frequency – Machine Type



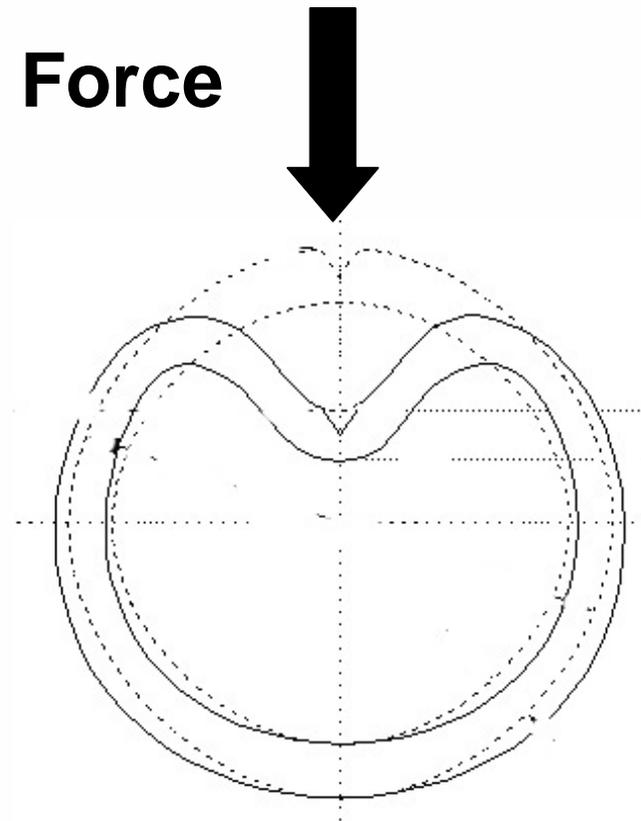
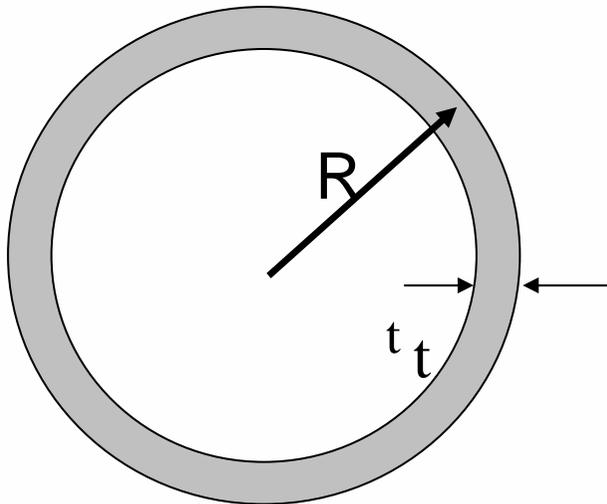
Random damage occurs on uncontrolled sites

Type of machine on such sites are limited

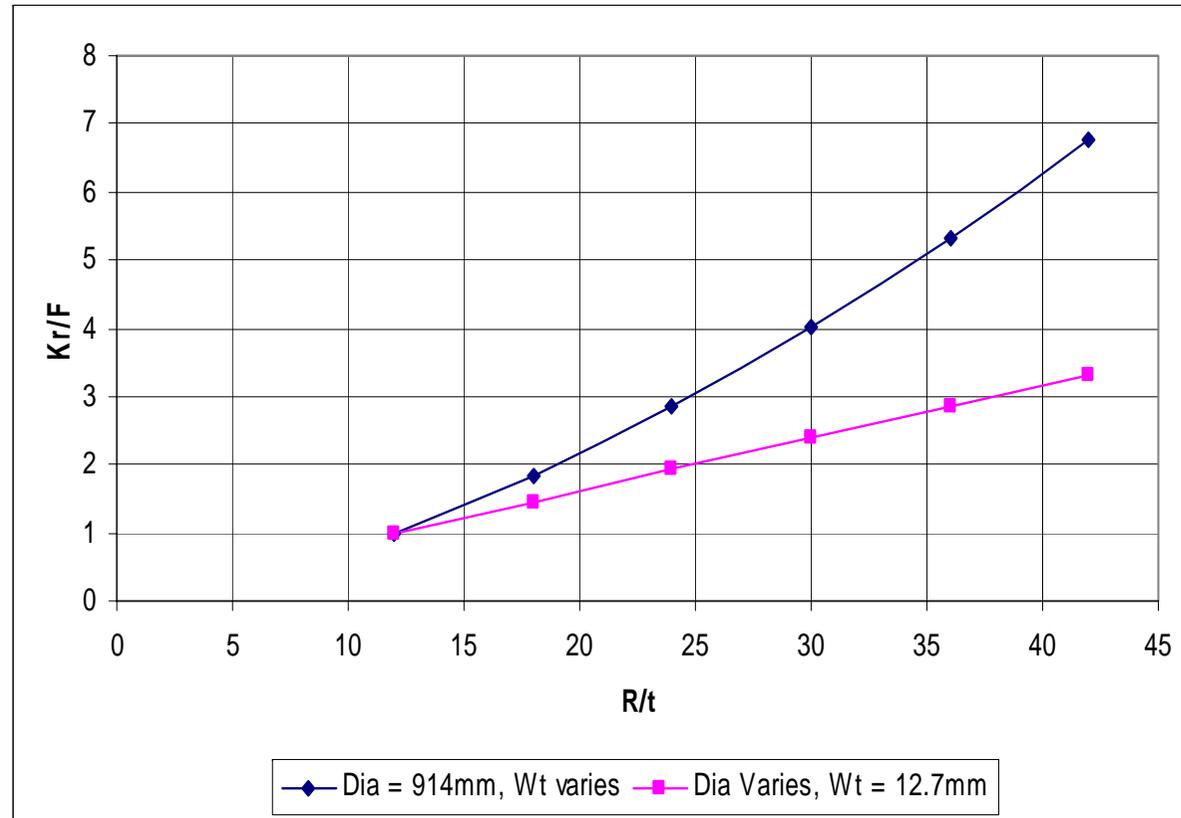
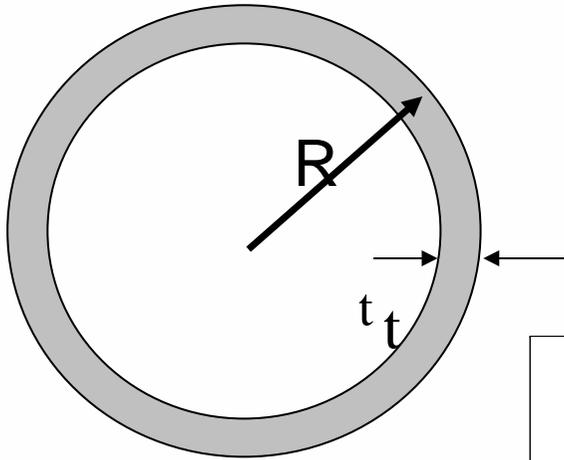
-
- • Magnitude of force is limited

Pipe and Damage Geometry

Resistance :-
 R/t



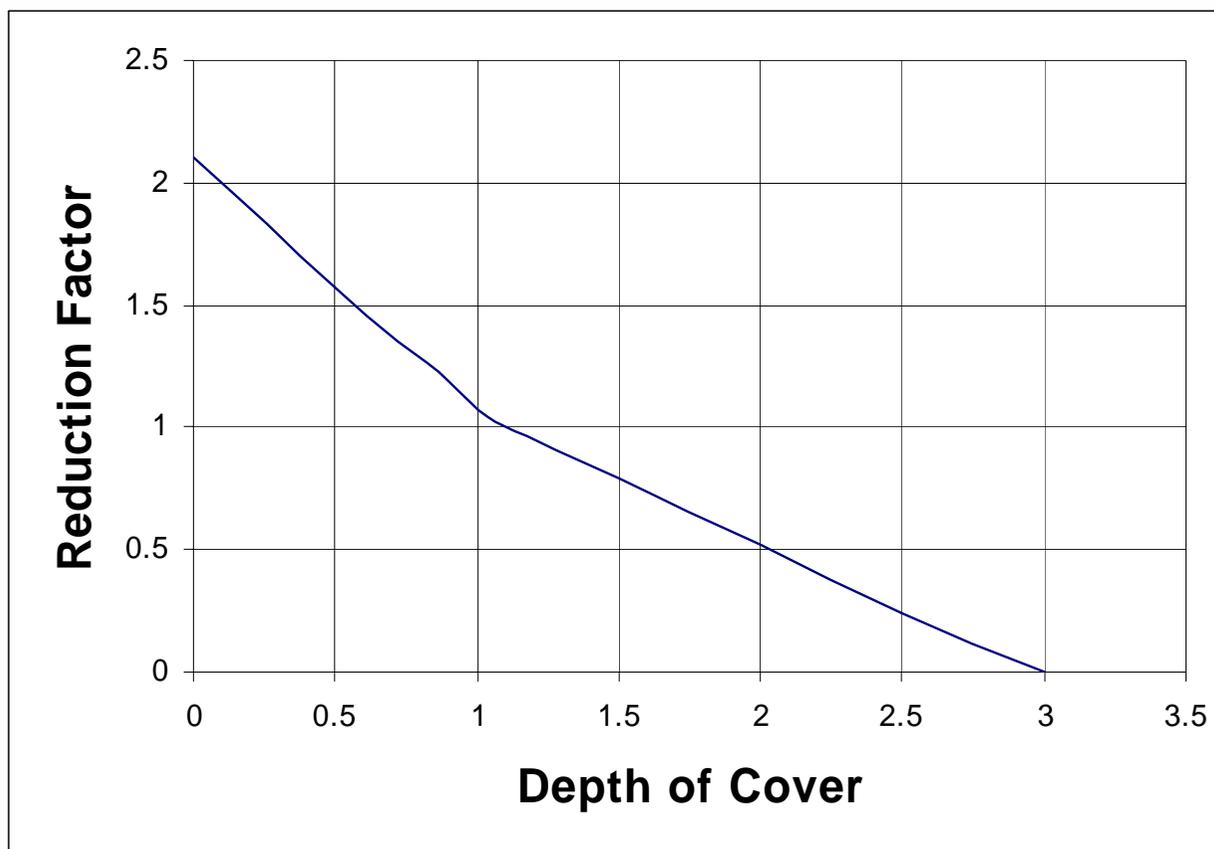
Pipe Geometry – Effect of R/t Ratio



Failure Frequency Due to 3rd Party Damage Dependencies

- Force magnitude varies with Machine type
- Machine types are limited so Force magnitude is limited
- Dent/Gouge geometry depends upon Force and Pipe Geometry
- Likelihood of Dent/Gouge failure depends upon Pipe Geometry and Pressure/Design Factor

Influence of Depth of Cover



Outline Content

- Application of risk mitigation measures:
 - Assessment of depth of cover
 - Installation of slabbing
 - Additional markers
 - Additional surveillance
 - Awareness/Liaison

Mitigation Methods for Risk Reduction

Mitigation methods:-

- essential part of risk management
- risk reduction in accordance with code requirements
- target cost effective expenditure on reducing risks
- categorised as “hard” (engineering) and “soft” (systems) measures

Engineering - slabbing / barriers over pipeline, deeper burial, more marker posts, thicker pipe

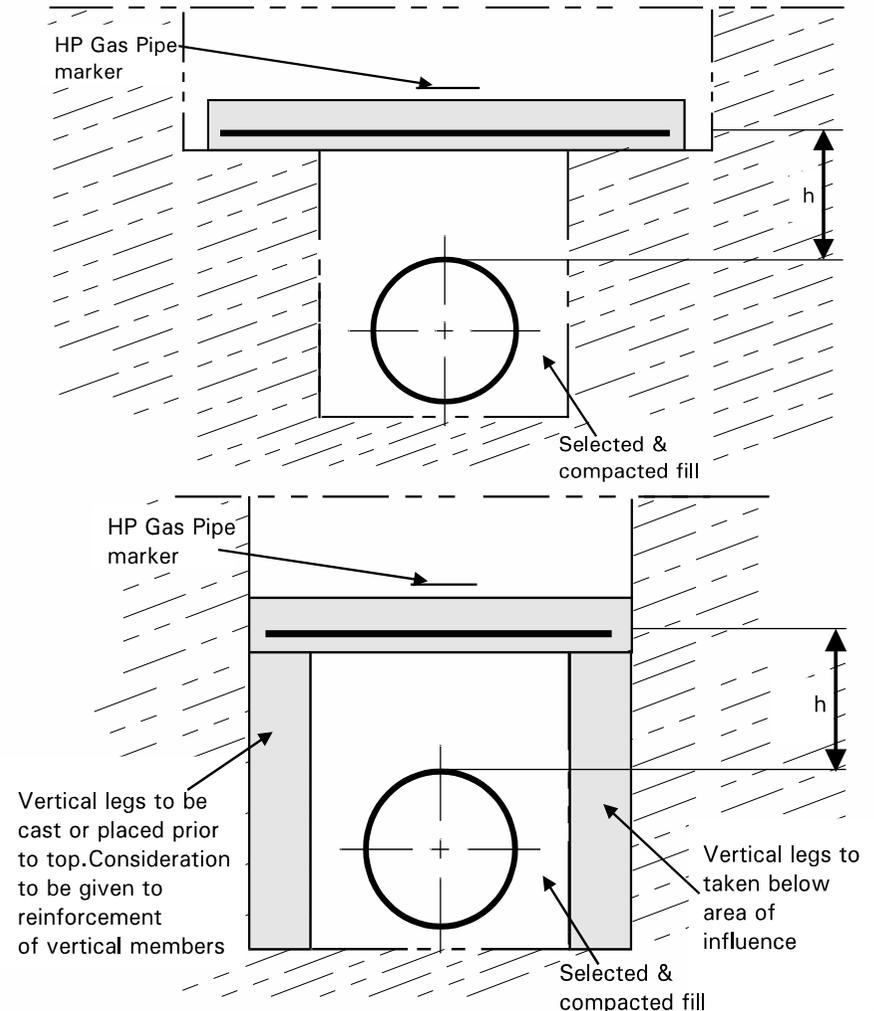
Systems - increased route surveillance, one-call systems.....

Need to be able to account for risk reduction factors in risk analyses to be able to assess mitigation requirements

Mitigation Methods – Slabbing and Marker Tape – IGE/TD/1

Extensive trials by British Gas in early 1990s showed :-

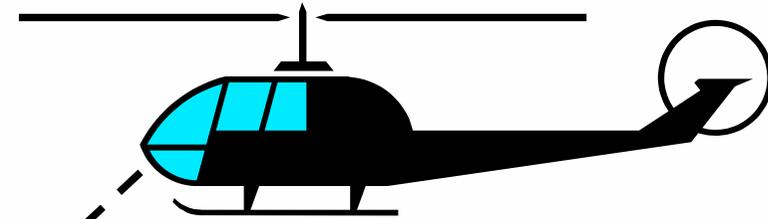
- substantial reduction in risk by protecting pipeline with slabbing and marker tape (no damage in 30 trials)
- combination of mechanical protection (slabbing) and human factors (tape)
- risk reduction factor developed by Fault Tree analysis



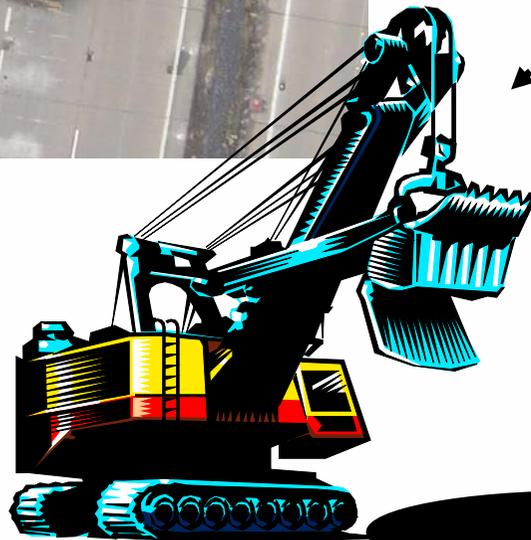
Reduction Factors – Additional Measures

Measure	Reduction Factor
High visibility markers	0.9
Additional Liaison visits	0.9
Installation of slabbing	0.4
Installation of slabbing – with marker tape	0.1

Mitigation Methods – Increased Surveillance

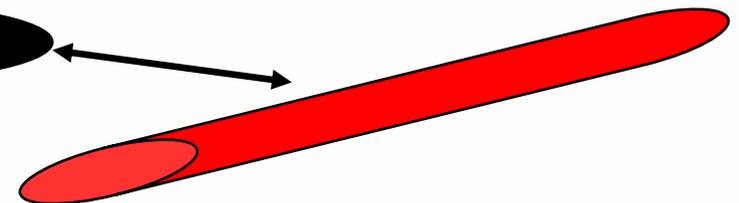


Frequency of Surveillance ?



When does excavation start?

How long to reach pipeline?



Influence of Surveillance Interval

