



Perforation Design for Novel P & A Method

**Cato Prestegård
Darren Barlow P.E.
John Hales**

HALLIBURTON

Efficiency

ایکیا

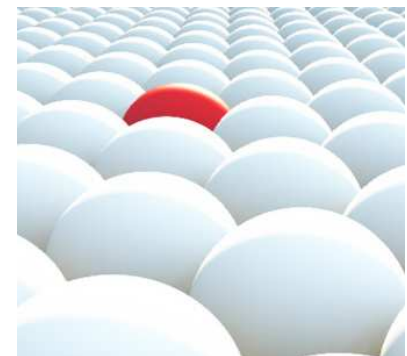
IKEA



www.builtlean.com

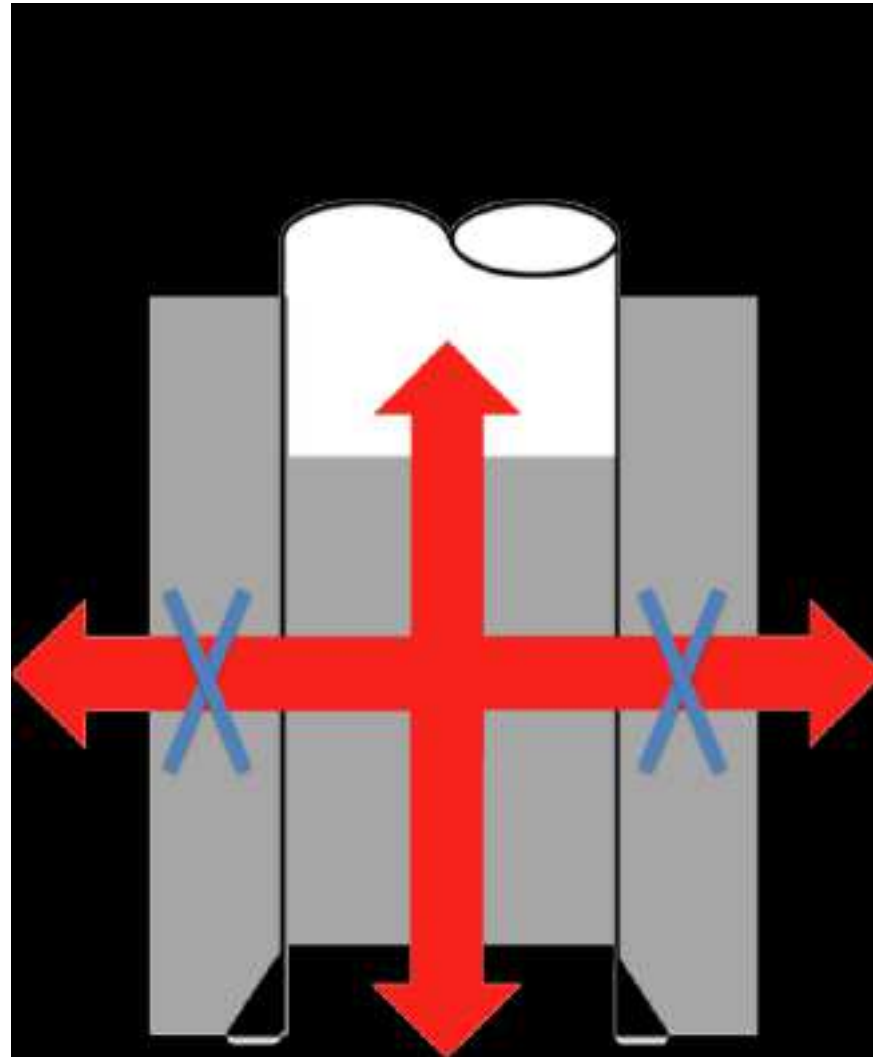


www.bosbouwbeleggingen

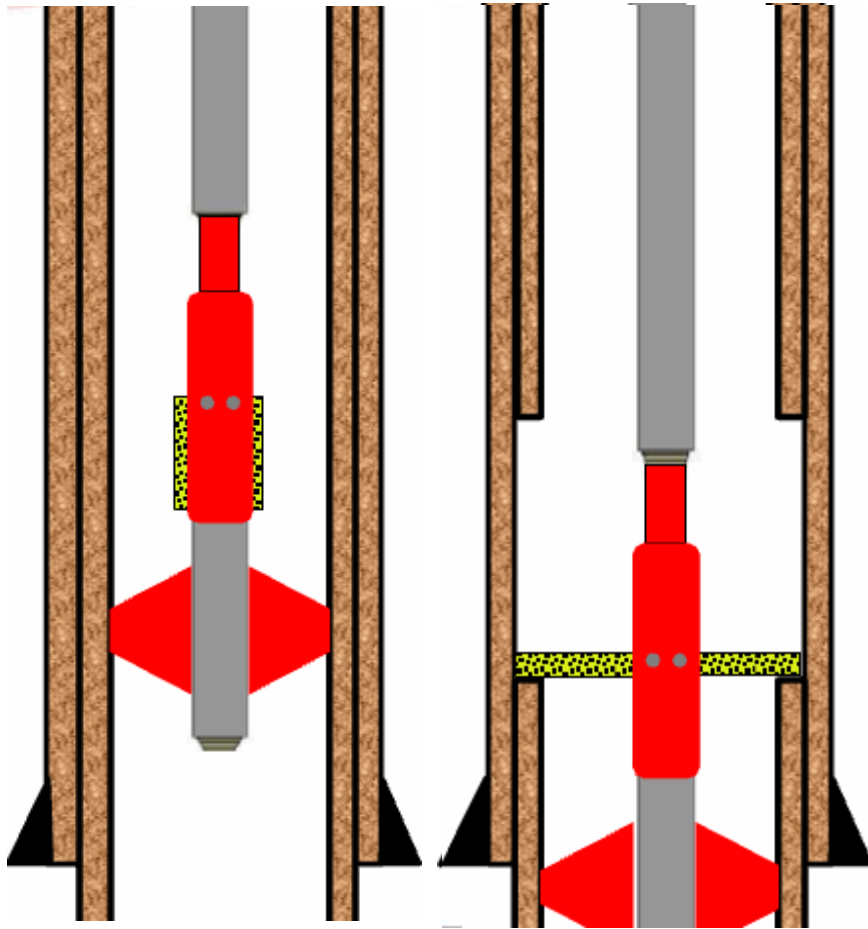


www.digitalimagemagazine.com

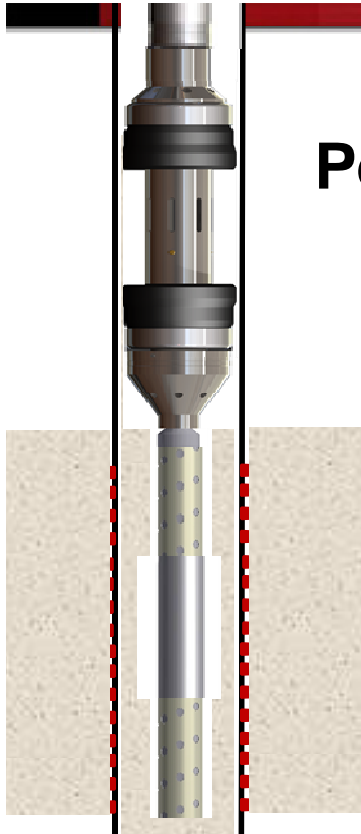
Driving Factor



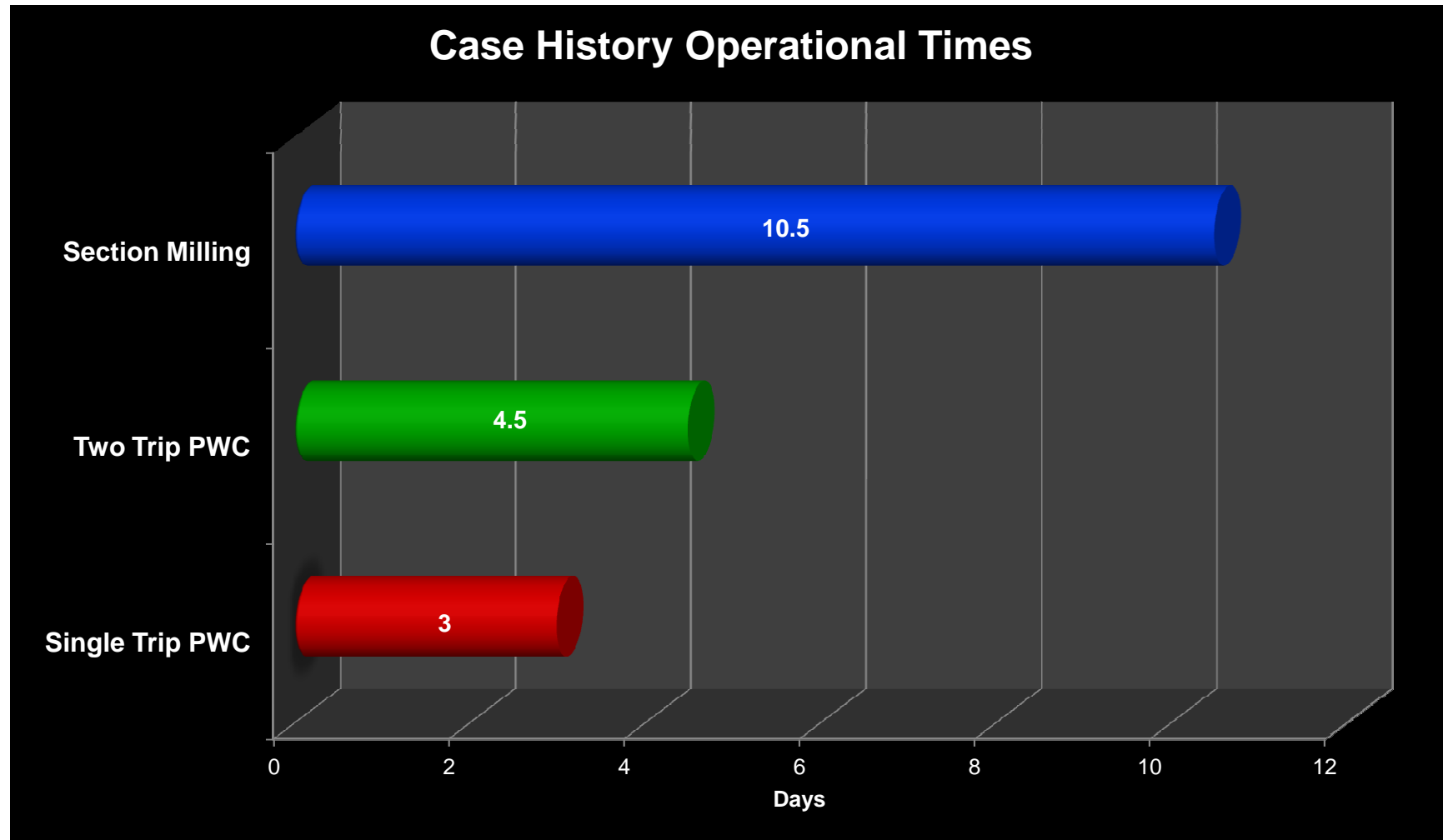
Section Milling



Perforate Wash Cement (PWC)



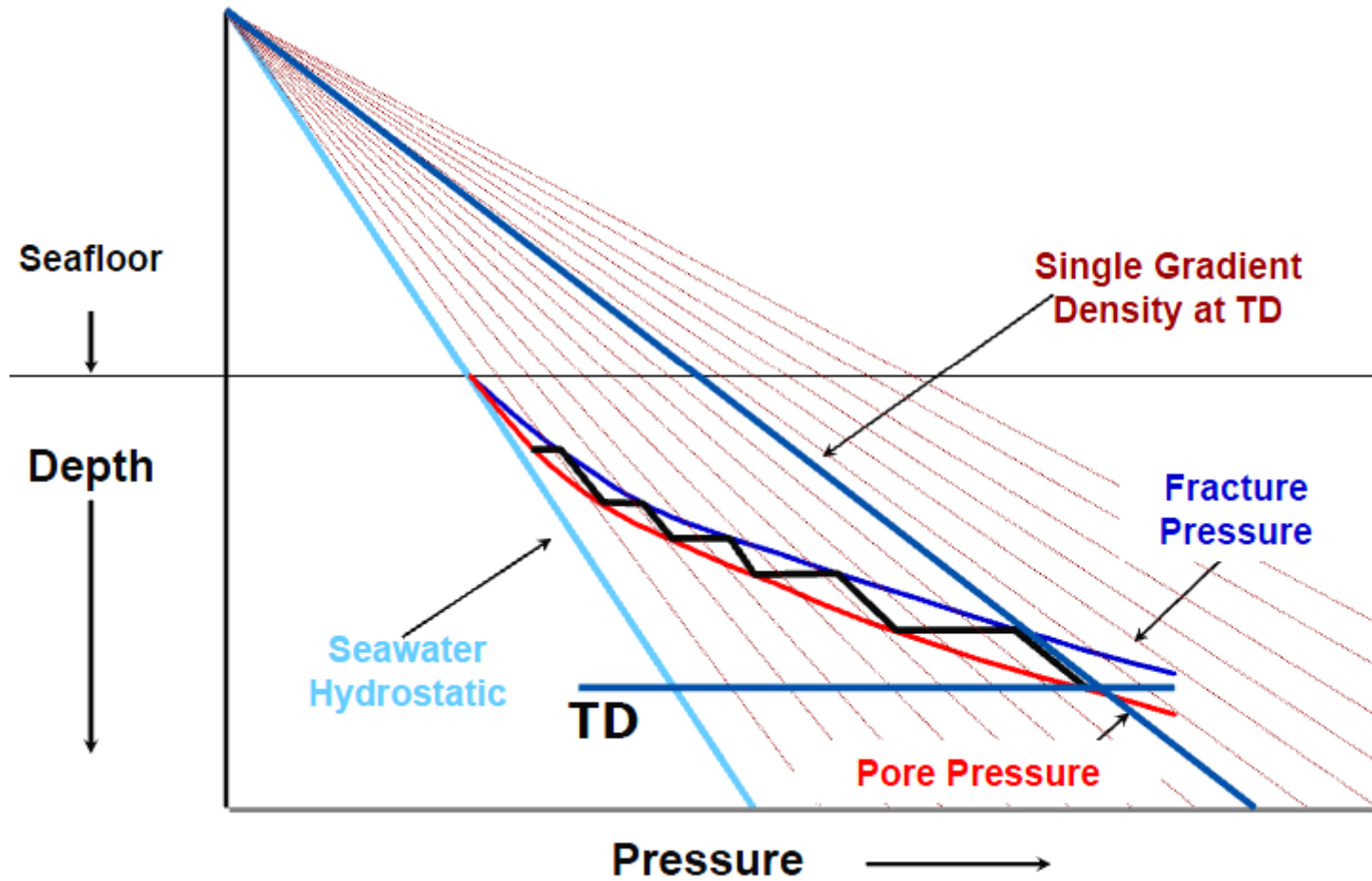
North Sea Experience



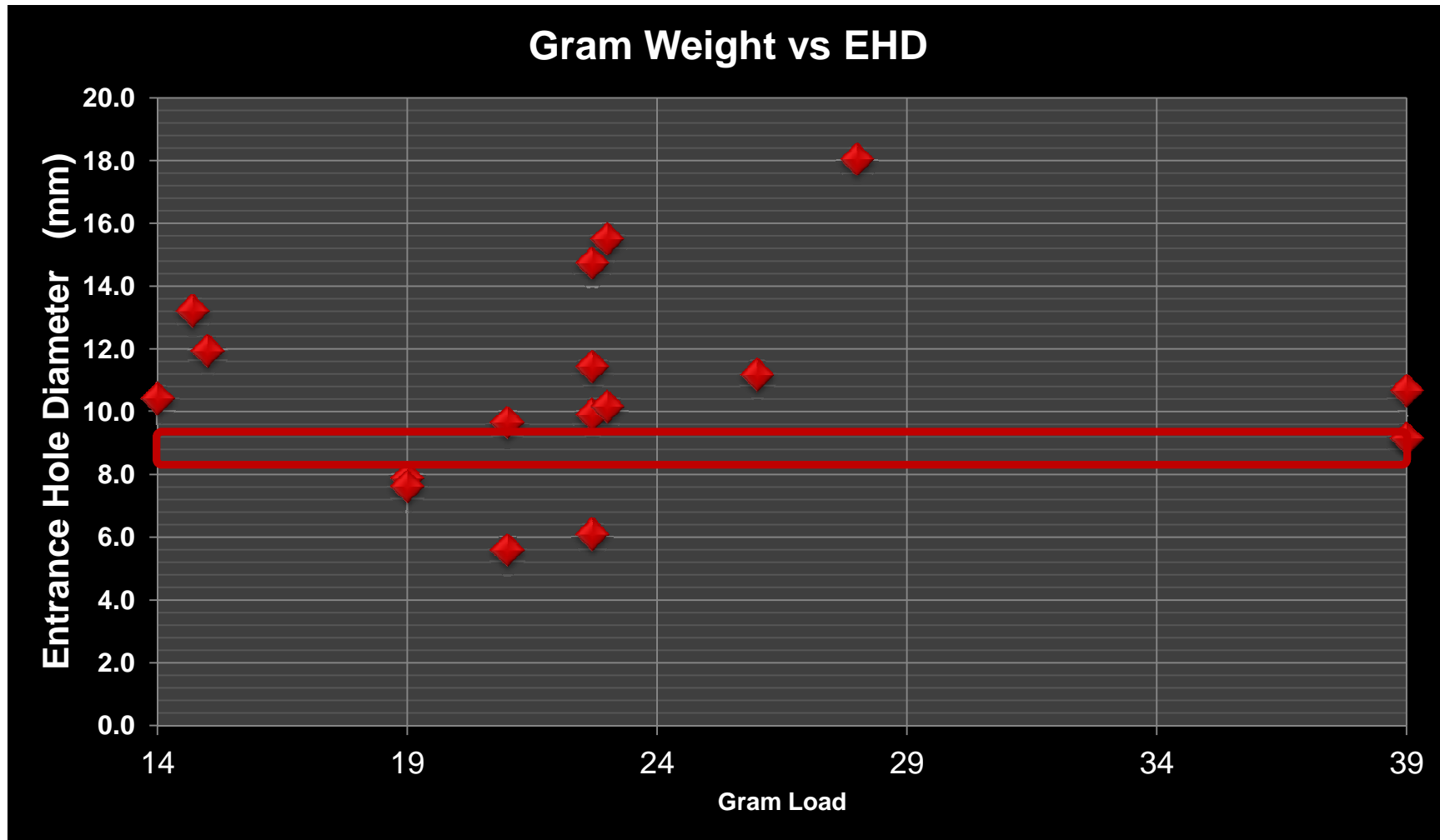


Critical Design Factors

The Beginning of the End



The Initial Approach

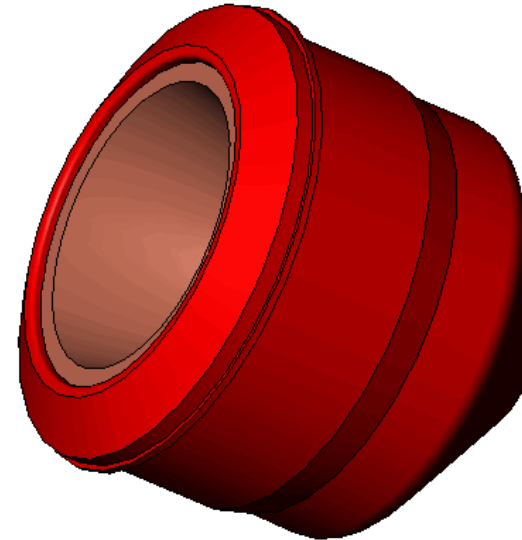


Engineered Approach

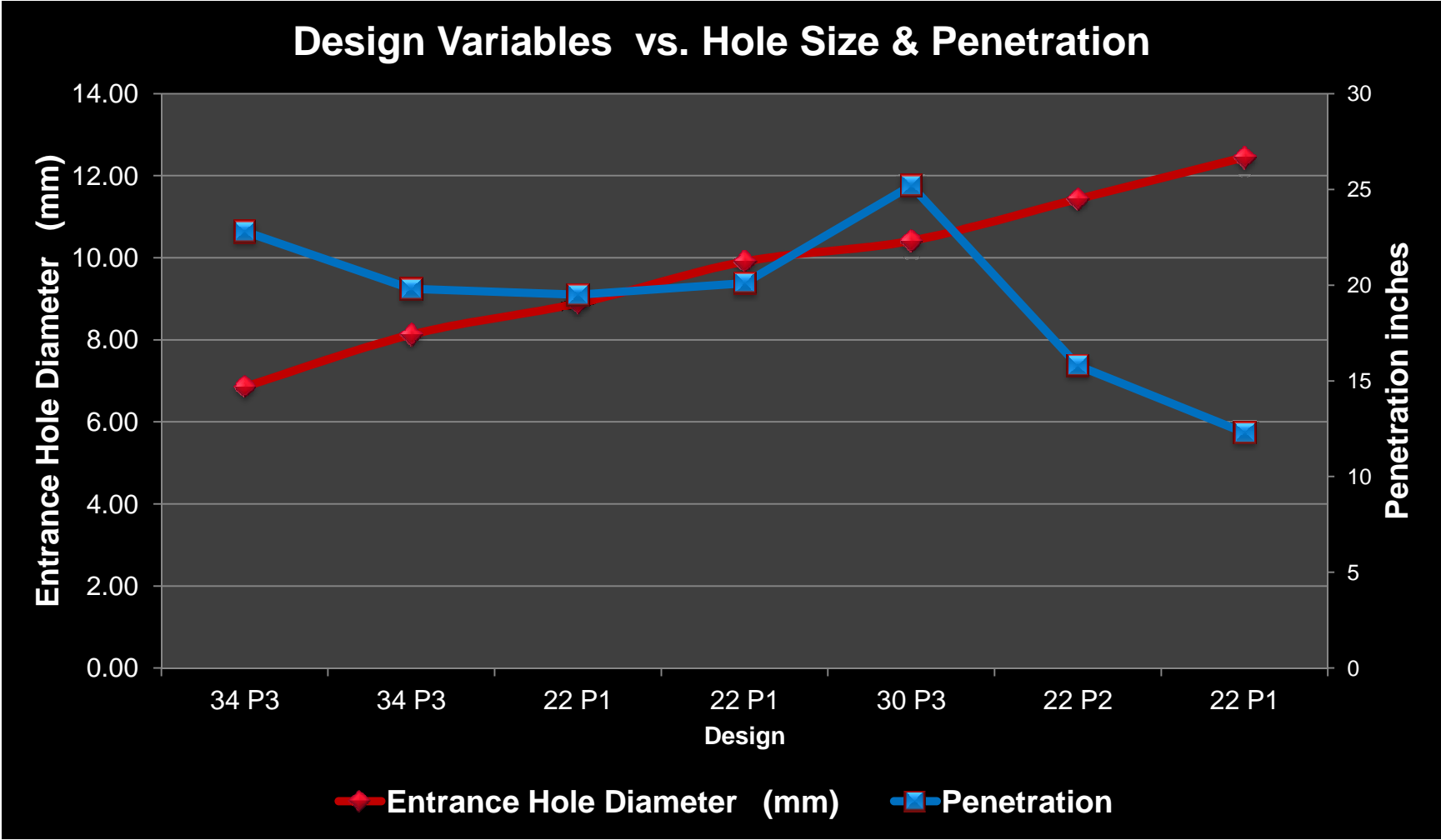
- Two deliverables
 - Diameter
 - Perforation Coefficient

- Four design Variables
 - Liner Material
 - Weight
 - Shape
 - Explosive

$$\Delta P_{PERF} = \frac{MUD_{PPG} * Q^2}{12035 * A_{PERF}^2 * Cd^2}$$

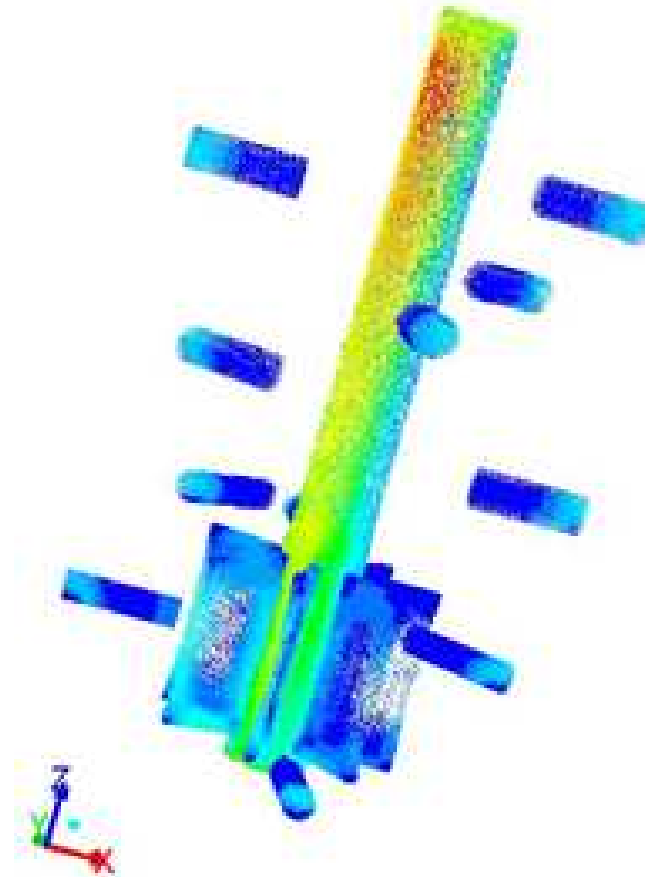


Design for the Future



Optimizing the System Performance

- Pressure
- Velocity
- Flow Rate
- Geometry



Source: Msc Dissertation Charles Nnaemeka Ukwuegbu, RGU University, Aberdeen



Designing Out NPT

Al-Qahira



Source: Wikipedia



Source: epmag.com

Simple Formula for Calculating Strength Degradation of Well Casings and Pipelines Due to Corrosion Pitting

$$SCF = \frac{b^2 \cdot \gamma - (a-h) \cdot \sqrt{b^2 - (a-h)^2}}{b^2 \gamma - a^2 \beta - (a-h)^2 (tg \gamma - tg \beta) + \frac{a^3 (4m - 5mv + 3a^2 n)}{(7-5v)}} \cdot \frac{27-15v}{14-10v}$$

$$a = \frac{d^2 + 4h^2}{8h}$$

$$b = a - h + t$$

$$\beta = \arccos\left(\frac{a-h}{a}\right)$$

$$\gamma = \arccos\left(\frac{a-h}{b}\right)$$

$$m = \frac{\sin \gamma - \sin \beta}{a-h} + \frac{\beta}{a} - \frac{\gamma}{b}$$

$$n = \frac{3 \sin \gamma - 3 \sin \beta - \sin^3 \gamma + \sin^3 \beta}{3(a-h)^3} + \frac{\beta}{a^3} - \frac{\gamma}{b^3}$$

$$2 > SCF < 3$$

New Pipe Formula

$$P_b = 0.875 \times 2\sigma_y \left(\frac{t}{d_o} \right)$$

13 3/8 98 ppf N80 casing

$$P_b = \frac{7,505}{2.67}$$

$$P_b = 2,810 \text{ psi.}$$

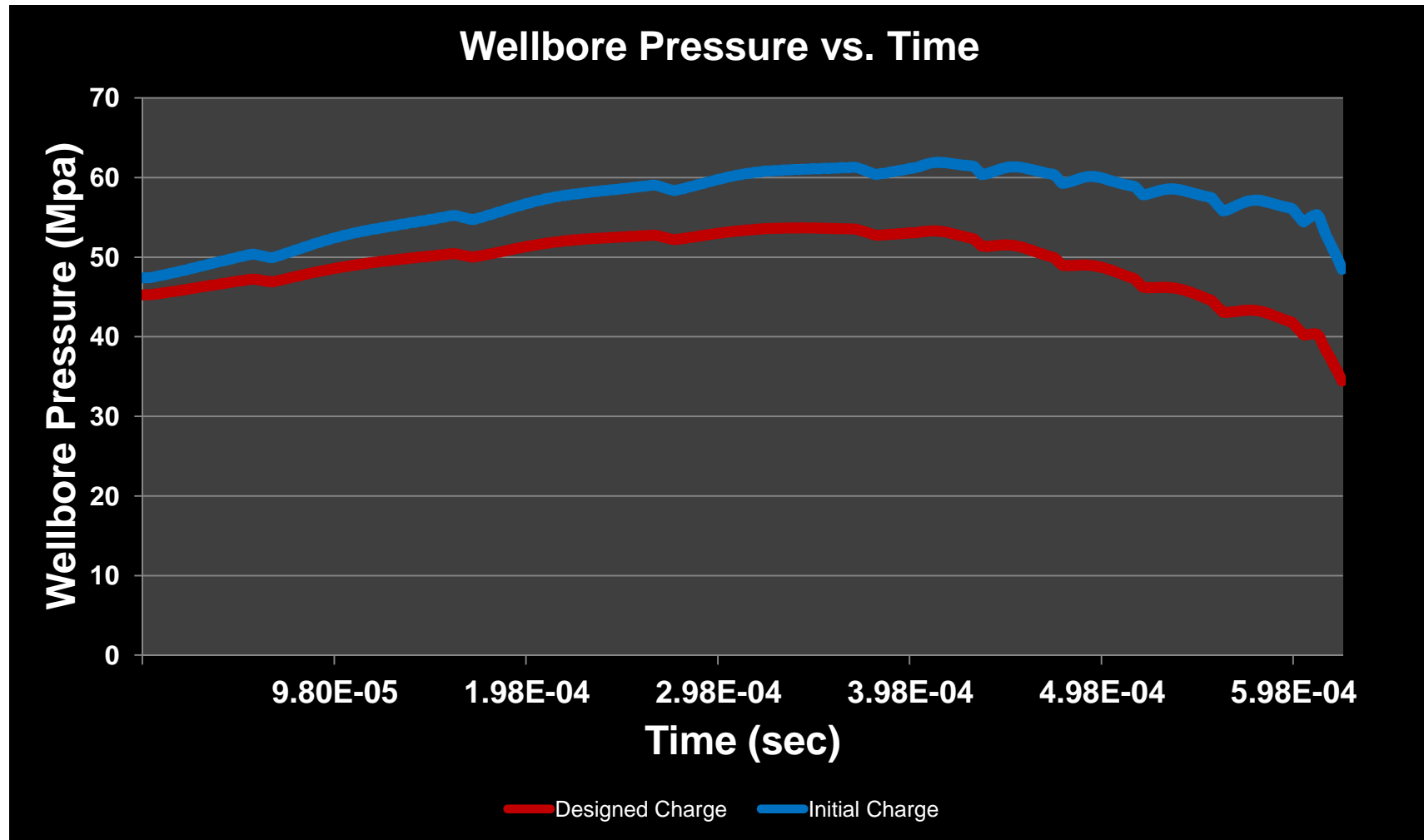
- Source SPE 88572 by Kai Sun and Guo Boyun

Optimizing the System



Sources: nmi.com,

Minimizing the Pressure Effects





**What challenges do you have for the
Perforate, Wash, Cement System?**

**Ikea
Charge Design
Low Actuating Pressure**