

Assignment 3

(In Situ Stresses Calculations)

Assume that a 100 ft shaly sand formation is 11000 ft deep. The density is 165 lb/cu.ft, the poro-elastic constant is 0.72, and the Poisson ratio is 0.26. Calculate and plot the absolute and effective vertical and minimum horizontal stresses. The maximum horizontal stress is 3000 psi larger than the minimum horizontal stress. Plot the maximum stress also. Use hydrostatic reservoir pressure (oil density = 50 lb/Cu.ft).

Repeat the calculations, but plot the stress profile of the target interval and overlaying and under-laying shale layers, each 50 ft thick. Use first a Poisson ratio for shales equal to 0.26 and then repeat for Poisson ratio 0.35 and 0.4. Finally, plot the absolute vertical and minimum horizontal stresses at 11000 ft as functions of the reservoir pressure from hydrostatic to an overpressure of 6000 psi. What observations can be made?

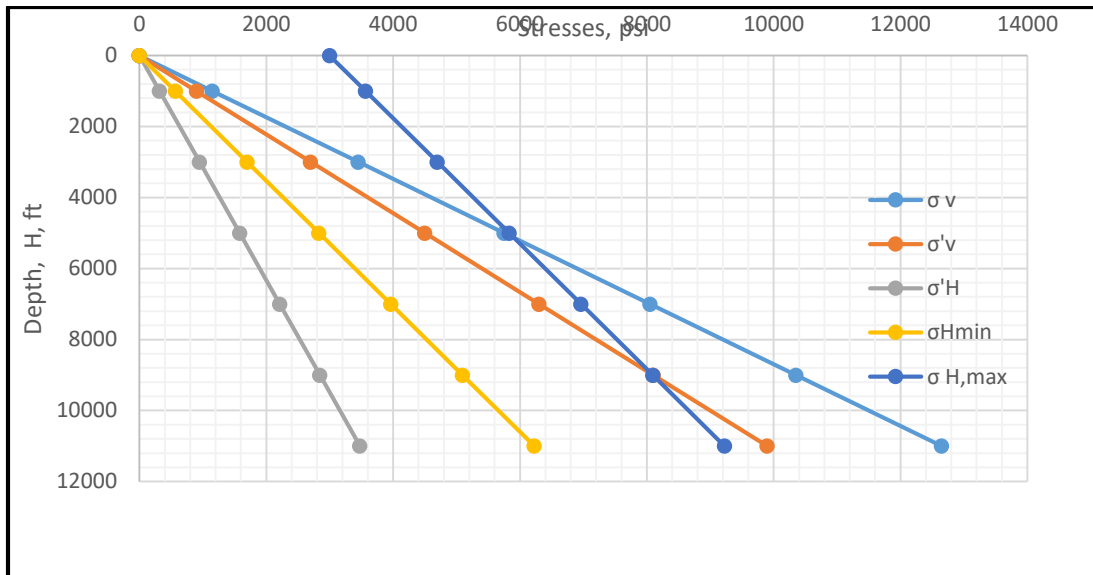
Solution

$$\sigma_v \sim = 1.15H - \frac{0.72 \times 50 \times H}{144} = 0.9H$$

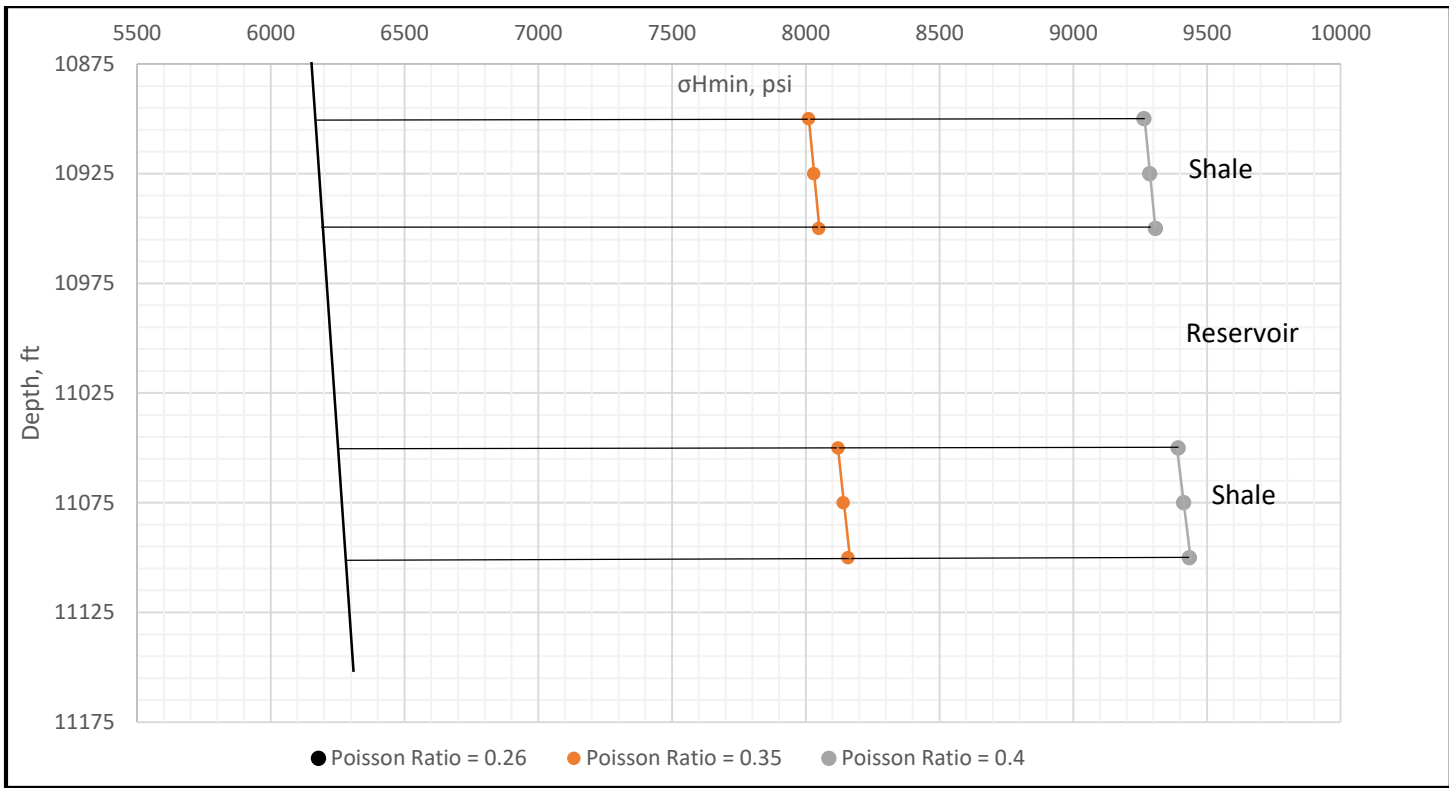
$$\sigma_H \sim = \frac{0.26}{1 - 0.26} (0.9H) = 0.316H$$

$$\sigma_{H,min} = 0.316H + \frac{0.72 \times 50 \times H}{144} = 0.566H$$

Depth, ft	11000	9000	7000	5000	3000	1000	0
Poisson Ratio	0.26						
σ_v , psi	12650	10350	8050	5750	3450	1150	0
σ'_v , psi	9900	8100	6300	4500	2700	900	0
σ'_H , psi	3476	2844	2212	1580	948	316	0
σ_{Hmin} , psi	6226	5094	3962	2830	1698	566	0
$\sigma_{H,max}$, psi	9226	8094	6962	5830	4698	3566	3000



Depth, ft	10875	10900	10925	10950	10975	11000	11025	11050	11075	11100	11125	11150
Poisson Ratio	0.26											
σ_{Hmin}, psi	6155.25	6169.4	6183.55	6197.7	6211.85	6226	6240.15	6254.3	6268.45	6282.6	6296.75	6310.9
Depth, ft	10875	10900	10925	10950	10975	11000	11025	11050	11075	11100	11125	11150
Poisson Ratio	0.35											
σ_{Hmin}, psi	7993.125	8011.5	8029.875	8048.25	8066.625	8085	8103.375	8121.75	8140.125	8158.5	8176.875	8195.25
Depth, ft	10875	10900	10925	10950	10975	11000	11025	11050	11075	11100	11125	11150
Poisson Ratio	0.4											
σ_{Hmin}, psi	9243.75	9265	9286.25	9307.5	9328.75	9350	9371.25	9392.5	9413.75	9435	9456.25	9477.5



σ_v , psi	12650	12650	12650	12650	12650	12650	12650
σ_{Hmin} , psi	6270	6750	7230	7710	8190	8670	9150
ΔP , psi	0	1000	2000	3000	4000	5000	6000

