Compression Sections React to Land Subsidence

Introduction

Land subsidence is brought about by various man-related activities where, for example, fluids such as oil and water are pumped from the subsurface. As these fluids are removed from the underground reservoirs, their extraction can be followed by compaction of the reservoir materials and the sediment(s) such as silt and clay beds that overlie them. As these materials become compressed by the reduced pressure, the beds are compacted. The changes that take place in these beds are sometimes measured in tens of feet, and are directly linked to major problems with infrastructure (building settlement, cracking in street pavement, breaks in pipelines, and failures in water wells). In addition to these effects, fissures (i.e., cracks) on the ground surface can occur that are several feet wide and many miles in length.

Within the United States, in post-World War II years, large-scale ground water pumping within the Southwest increased dramatically as the demand for water for potable and irrigations supplies grew. Similarly, for example, in Mexico the growing demand for water has triggered increased ground water pumping. Anecdotal reports indicate that in parts of Mexico, ground water pumping has caused local declines in the ground water level of 1 meter per year and land subsidence of 6 inches.

When land subsides in the vicinity of a well (or well field), the subsurface soils and aquifer(s) create considerable stress to the well casing. In some cases, when these stresses are transmitted to the well, they can (and have) caused catastrophic failures when the casing is unable to resist the compressive forces.

This memorandum describes the design and use of compression sections that allow a well to withstand forces related to subsidence without experiencing catastrophic failure.

Function

Steel well casing exhibits a high modulus of elasticity. Therefore, small strains are able to easily cause axial compression loads that exceed steel casing's strength. The solution to this problem is a compression section which allows the casing to telescope and thereby account for the settlement force. Compression sections are typically installed at the bottom of the blank casing (i.e. pump chamber) above the well screen. It should be noted that a compression section cannot be retrofitted to an existing well. The potential for subsidence must, therefore, be identified, during the design phase of the well. During the design, it is best, if possible, to decide where the compression section should be installed based on the history of the area, and by examining existing wells that have failed due to such strains. Multiple (i.e. two or three) compression sections can be installed, if so desired.

Design and Manufacturing

Roscoe Moss Company manufactures a single compression section and a double compression section. Design details of the two styles are shown on Figures 1 and 2. Both styles consist of a 6-foot long shell that spans/connects the casings above and below the shell. Both styles allow the casing at the upper end to travel downward within the shell. Compression sections in either

style can be manufactured in diameters ranging from 6 to 24 inches. The wall thickness of the shell is manufactured in the same thickness as the well casing welded to the shell.

Efficacy

The compression section has shown itself to function effectively so that it reacts directly to site-specific settlement. A compression section should be installed whenever there is evidence of such failures in existing wells or when there are visible indicators that there is active subsidence.

References

- Association of Environmental & Engineering Geologists, 2009 - website
- Roscoe Moss Company, 1990, *Handbook of Ground Water Development,* John Wiley and Sons, New York, NY.
- Leaks, S.A., Land Subsidence From Ground-Water Pumping, (undated), http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/

About the Author

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Figure 1 – Single Style

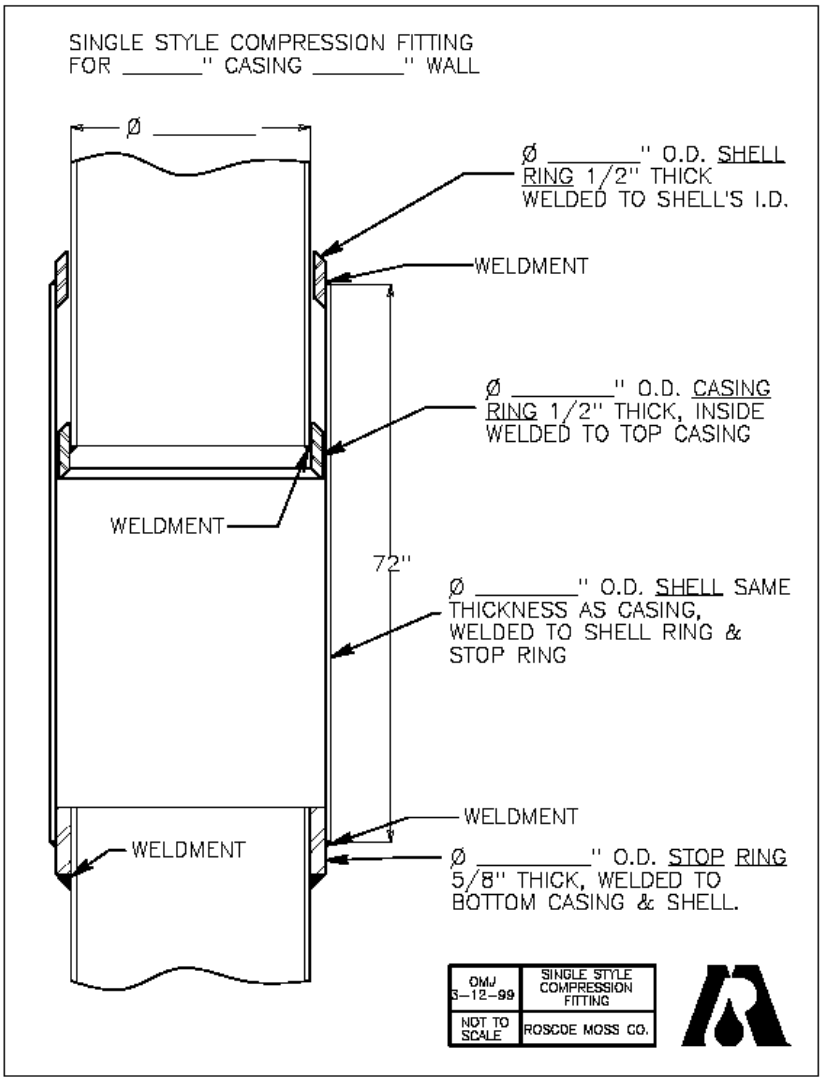

Figure 2 – Double Style