Allowable Strain in Buildings and Structures

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Subsurface injection can cause slight vertical and lateral displacements of the ground surface. Any structures erected on the ground surface will be subjected to these movements. Each building has its own unique construction and thus response. Whether the displacements are destructive to the building best can be determined by those qualified in the art and science of building construction, e.g. licensed civil engineers.

One value of tolerance to be expected from buildings can be found in manuals for engineers and designers involved in the use of structural steel. In the US Steel manual, the tolerance appears almost incidentally as an explanation of the basis for some of the tables in the text:

> "The load and equivalent span are given where the deflection is 1/360 of the span length, the limit for plastered ceilings."

Allowed deflection is a linear movement. A companion angular movement can be assumed by comparing deflection to the length of span. The angle will be smallest when the comparative length is greatest. The location of maximum deflection relative to an end of the span will be greatest when the maximum deflection is at the center of the span. Thus we can develop an angular tolerance, α, for plastered ceilings:

$$\alpha = ArcTan\frac{\left({}^{1}/_{360}\right)(spanLength)}{\frac{spanLength}{2}} = ArcTan\frac{1}{180} = 0.00555\ Radians \approx 5500\mu R$$

Plaster surfaces probably are one of the most sensitive structures that we encounter in buildings. We think of plaster as being brittle and easy to crack. All but the finest cracks are considered defects. Without further instruction, it seems reasonable to adopt the tolerance of plaster as a limit for deformation created by subsurface injection under buildings.

References:

Pocket Companion - Information and Tables for Engineers and Designers and Other Data Pertaining to Structural Steel. United States Steel Corp. Pittsburgh, Pennsylvania. 1936.

Bethlehem Manual of Steel Construction. Bethlehem Steel Corporation. Bethlehem, Pennsylvania. 1934.