SOIL-FOUNDATION SYSTEM

STATIC APPROACH

1840 **Sir William Thomson**

Expressions for the displacements elicited by concentrated static forces acting at some arbitrary point in an elastic infinite solid

1849 **Sir George Gabriel Stokes**

Extends Thomson's solution to time varying point forces in an infinite medium, known as **Stokes solution**

1878 **Joseph V. Boussinesq**

Solutions for static vertical point loads and rigid disk applied onto an elastic half-space

$K_z = \dfrac{4Ga}{1-\nu}$	$\sigma_z = \dfrac{P_z}{2\pi a\sqrt{s^2-r^2}}$

1882 **Valentino Cerruti**

Response in the interior of an arbitrary solid due to forces prescribed on parts of the external by tractions or displacements

1893 **Fr. Engesser**

Stability and carrying capacity of foundations ("The theory of soils")

1926 **Ferdinand Alois Schleicher**

Confirms Boussinesq results. Infers the Modulus of Subgrade Reaction. Formulas for loads distributed over rectangular areas. For displacements: $\delta_{corner} = ½\ \delta_{center}$

1934 **Wilhelm Steinbrenner**

Vertical stresses anywhere from stresses underneath the symmetry center of the loaded rectangular area, and from there to the corners.

1943 **H. Borowicka**

Stress distribution under strip footings and circular disks subjected to eccentric vertical loads; formulas for rocking stiffness (Kr)

Disk	$K_r = \dfrac{4Ga^3}{3(1-\nu)}$	$\sigma_r = \dfrac{3r\cdot\cos\theta\cdot Mr}{2\pi a^3\sqrt{a^2-r^2}}$
Strip	$K_r = \dfrac{4Ga^2}{2(1-\nu)}$	$\sigma_r = \dfrac{2x\cdot Mr}{\pi a^2\sqrt{a^2-x^2}}$

1944 **Reissner and Sagoci**

Torsional stiffness (Kt) of a circular plate welded to an elastic half-space

$K_t = \dfrac{16Ga^3}{3}$	$\sigma_z = \dfrac{3r\cdot Mt}{4\pi a^3\sqrt{a^2-r^2}}$

1949 **Raymond David Mindlin**

Lateral stiffness (Kh) of a rigid circular disk subjected to tangential/horizontal loads

$K_h = \dfrac{8Ga}{2-\nu}$	$\tau_{xy} = \dfrac{P_x}{2\pi a\sqrt{a^2-r^2}}$

1974 **Mooney**

Generalized solution for vertical point loads in a half-space with arbitrary Poisson's ratio for the horizontal component.

DYNAMIC APPROACH

1904 **Horace Lamb**

Solution for a homogeneous half-space subjected to a dynamic load on its surface, known as **Lamb's problem**.

1931 **Karl Maguerre**

Attempt to deal with harmonically loaded soils, limited by complexity of the problem

1936 **Cagnaird / Erich Reissner**

Double integral transforms in Lamb's problems / Analyzed circular disks on elastic half-spaces subjected to time-harmonic vertical loads.

1937 **Erich Reissner**

Elastic half-space excited at the surface by concentrated and distributed torsional sources. **Radiation damping** and **equivalent mass-spring-damper** analogy

1944 **Reissner and Sagocy**

Rigorous solution to mixed boundary value problem with dynamically loaded plate.

1956 **Bycroft**

Dynamically loaded circular plates resting on half-spaces and on strata of finite depth.

1960 **De Hoop / Pekeris-Chao**

Cagnaird-de Hoop simplificated method / Impulsive vertical and horizontal point loads in a half-space for Poisson ratio of 0.25

1963 **Thomson and Kobori**

Rectangular foundations subjected to vertical loads, resting on half-spaces and on strata.

1965 **Awojobi and Grootenhuis**

2-D strip footings subjected to vertical loads

1967 **Chadwick and Trowbridge**

Rigid sphere in a full-space subjected to torsion, in frequency and time domains.

1976 **Apsel and Luco**

Exact solution to the torsional response of ellipsoidal in an elastic half-space.

STRUCTURAL SYSTEM

1935 **Sezawa and Kanai**

Resonance effect remains limited due to loss of energy in the soil (SSI beneficial). Plotted amplification functions.

1940 **Romeo Martel**

Damage to building in soft soils, deep alluvia or high elevations are higher than in those supported on firm ground

1954 **Merrit and Housner**

Lateral compliance has little effect. Effects of rocking depend on the ground motion and the height of the building

1957 **Housner**

Waves in the ground propagating along the long direction of the building had more filtering. Known as **Kinematic Effect**

1967 **Parmelee**

Evaluated SSI Effects in a 3 DOF system on lateral and rocking springs. Considered frequency dependence of K functions.

1969 **Nathan Newmark**

Torsional effect in symmetric buildings due to the difference in the time of excitation at different points of the foundation. Called this the Tau Effect

1970 **Sarrazín**

Damping values are low for rocking and high for swaying. SSI effect reduces disp. Hysteretic damping is important.

1976 **Scanlan**

Well know large study on Tau Effect

1977 **Veletsos**

Interacting systems can be modeled via simple systems with modified periods and appropriate levels of damping