

# 线性和非线性的统一强度理论

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摘要 统一性, 即将以前相互没有联系的概念、方法、理论、现象等统一起来, 这是一个科学理论美的重要特点之一。统一强度理论是一种新的序列化的理论, 它不仅建立起各种线性破坏准则的相互联系, 并且产生一系列新的准则。单剪强度理论、双剪强度理论和介于单剪强度理论与双剪强度理论之间的一系列线性准则均为它的特例。但是, 它没有将Huber-von Mises准则等非线性准则统一起来, 而只能线性逼近它们。根据一个新的力学模型, 提出一个普遍形式的统一强度理论, 它不仅将单剪强度理论和双剪强度理论的线性准则统一起来, 并且将八面体剪应力理论的非线性准则统一起来, 从而建立起各种强度理论之间的相互联系, 并将最常用的各种强度理论统一于一体, 形成一个线性和非线性准则统一的普遍形式的强度理论, 可以适用于更多的材料。

关键词 [岩土力学; 破坏准则; 单剪强度理论; 双剪强度理论; 八面体剪应力强度理论; 统一强度理论; 线性准则和非线性准则的统一; 统一强度理论的美](#)

分类号

## LINEAR AND NONLINEAR UNIFIED STRENGTH THEORY

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### Abstract

Unification of a priori unrelated concepts, methods, theories or phenomena is an important characteristic of the beauty of a scientific theory. Strength theory deals with the yield and failure of materials under the complex stress state. It includes the yield criteria

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(for those materials which have the same strength both in tension and compression) and failure criteria (for SD materials, i.e. strength difference of materials in tension and in compression). It is an important foundation for research on the strength of materials and structures. Strength theory is widely used in physics, mechanics and engineering. It is of great significance in theoretical research and engineering application, and is also very important for the effective utilization of materials. It is an interdisciplinary field where the physicist, civil and mechanical engineers interact in a closed loop. The unified strength theory gives a series of new failure criteria, establishes a relation among various failure criteria, and encompasses previous yield criteria and failure models as special cases. The single-shear strength theory including the famous Tresca yield criterion and the Mohr-Coulomb strength theory, the twin-shear strength theory including the twin-shear yield criterion and the twin-shear failure criterion are all special criteria of the unified strength theory. The unified strength theory has been applied to many fields. The unified strength theory is not a single criterion; it is a series of failure criteria, a system of strength theory. A series of new failure criteria and yield criteria between the single-shear theory and twin-shear theory can be introduced from the unified strength theory. The unified strength theory, however, is a combination of the linear criteria. It cannot unify the nonlinear criteria. It can only approximate nonlinear criteria. A new mechanical model and a new general unified strength theory of materials under complex stress state are proposed. It establishes a relation among various failure criteria including the linear and nonlinear criteria. The new theory encompasses the most familiar failure criteria as special cases; and a series of new criteria can be introduced. The single-shear strength theory, the twin-shear strength theory and the

octahedral-shear strength theory are all special cases of the new general unified strength theory. This new unified strength theory including the linear and nonlinear criteria can be adopted for more materials.

**Key words** [rock and soil mechanics](#); [failure criteria](#); [single-shear strength theory](#); [twin-shear strength theory](#); [octahedral-shear strength theory](#); [unified strength theory](#); [unification of linear criteria and nonlinear criteria](#); [beauty of unified strength theory](#)

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