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GENERAL TWO AXIS STATE OF STRESS GENERATION

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Aims and instruments for some general two axis state of stress generation. Specimen geometry. Loading and the state of stress components. Axial force, torque, internal and external pressure - their demonstrations in the elementary cube - see figs. 1, 2.

A special machine has been built in the department of Mechanics of material at the VŠB - Technical university OSTRAVA. This machine is intended to make possible:

- verifying a new ***strength criterion*** - designed for some workable material [1];
- measuring the ***limiting strain value*** under various loading conditions - using monotonously raised state of stress components [2];
- studying some various "***loading path effects***" (see later) upon the strength of cold strained materials - using different quality of the state of stress;
- searching the time-varying stress states effect on the ***fatigue process*** upon the material destroying phenomena;
- measuring the ***material response values*** upon loading conditions and the data storage for computing next constitutive equation of this material [3].

All of these tasks need to attend namely to the shape of the test specimens [4], to the testing machine design [5], to the measuring elements [6] and also to the control system elements [7].

Specimen - its loading and adequate state of stress component(s)

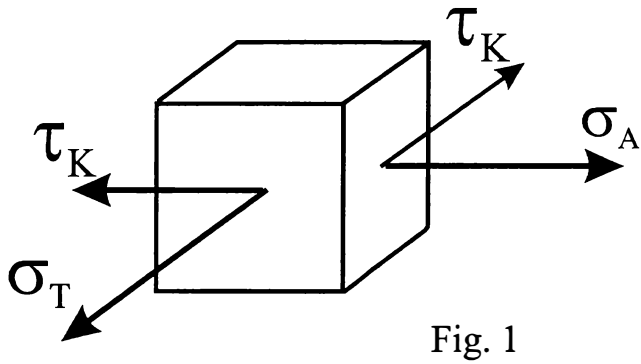
The basic specimen type is a hollowed, quasi-cylindrical shape with a low notch sharpness (with a large radius) on the external specimen surface.

Such shaped specimen can be:

- strained in tension or compression - using axial force F_A - thus axial ***tensile stress*** or axial ***compression stress*** is induced. Varying force $F_A(t)$ in time t - also $\sigma_A(t)$ varies in time;
- strained in shear - using torque M_K - thus ***shear*** components τ_K of the state of stress is induced. Varying loading torque $M_K(t)$ in time t - also $\tau_K(t)$ varies in time;

- strained using an internal pressure p_i on the internal (cylindrical) surface. If a special spindle is applied then only one ***tensile stress*** component σ_{Ti} is induced. Varying ()loading pressure $p_i(t)$ in time, also $+\sigma_T(t)$ varies in time;
- strained using external pressure p_e on the external (notched) specimen surface. It is possible to design some special chamber for this purpose. If this chamber can fit our demands then pressure p_e induces only one ***compression stress*** component $-\sigma_{Te}$. Varying (loading) external pressure $p_e(t)$ in time then also $-\sigma_{Te}(t)$ varies in time.

All declared straining effects can be superposed thus the final state of stress can be as follows in fig. 1.



$+\sigma_A$	if	$+F_A$
$-\sigma_A$	if	$-F_A$
$+\tau_K$	if	$+M_K$
$-\tau_K$	if	$-M_K$
$+\sigma_T$	if	p_i
$-\sigma_T$	if	p_e

Fig. 1

The generated stress components σ_A, τ_K, σ_{Ti}, σ_{Te} can be combined; they can be kept on some constant values or they can be varied in time - thus a qualitatively distinguish states of stress can be achieved in some specimen point. Components σ_A, τ_K, σ_T can be varied using the same or distinguish loading frequencies.
It is also possible to achieve some "loading path effect" using the step by step loading as is clear from the next example - see fig. 2:

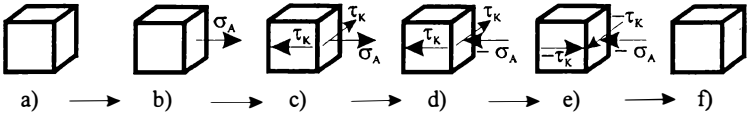


Fig. 2

- initial states - no loading effect is present - see fig. 2a;
- loading by the tensile force F_A - then $+\sigma_A$ tensile stress component is induced - see fig. 2b;
- keeping value of the force F_A by adding some new value of the torque M_K - then the $+\sigma_A$ and $+\tau_K$ are the new stress components - see fig 2c;
- keeping value of the torque M_K, adding opposite (compression) value of the force F_A - then the $-\sigma_A$ and $+\tau_K$ are the new stress components - see fig. 2d;
- keeping $-F_A$ value and adding opposite value ($-M_K$) of the torque then the $-\sigma_A$ and $-\tau_K$ are the new stress components - see fig. 2e;

- removing of all loading effects - see fig. 2f.

This procedure can be signed as "loading path" and adequate material behaving can be named as the "***loading path effect***".

Conclusion. New special machine for the material testing under variable and distinguish state of stress has been built in the Department of the Mechanics of Materials. This machine enables to test material under flexible test conditions - as it is clear from figs 1 and 2.

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