SOME CONSIDERATIONS REGARDING THE DETERMINATION OF THE RESIDUAL STRESSES

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INTRODUCERE

The tensions released by different mechanical methods leads to the appearance of a deformation (global or local). Any unwarrantable interference when balanced, will lead to a new balance and in consequence to a deformation of the mechanical part. This deformation can be global or local depending on the action type. By induced intended deformations, are obtained stresses that, generally, can be determined.

1. THE DETERMINATION OF REMANENT TENSIONS

The technique of the deformations measuring must be adapted to the problem, regarding the geometry of mechanical part and the action time. Using specific theory for this method and a correct sizing, we can determine the residual stresses – figure 1.

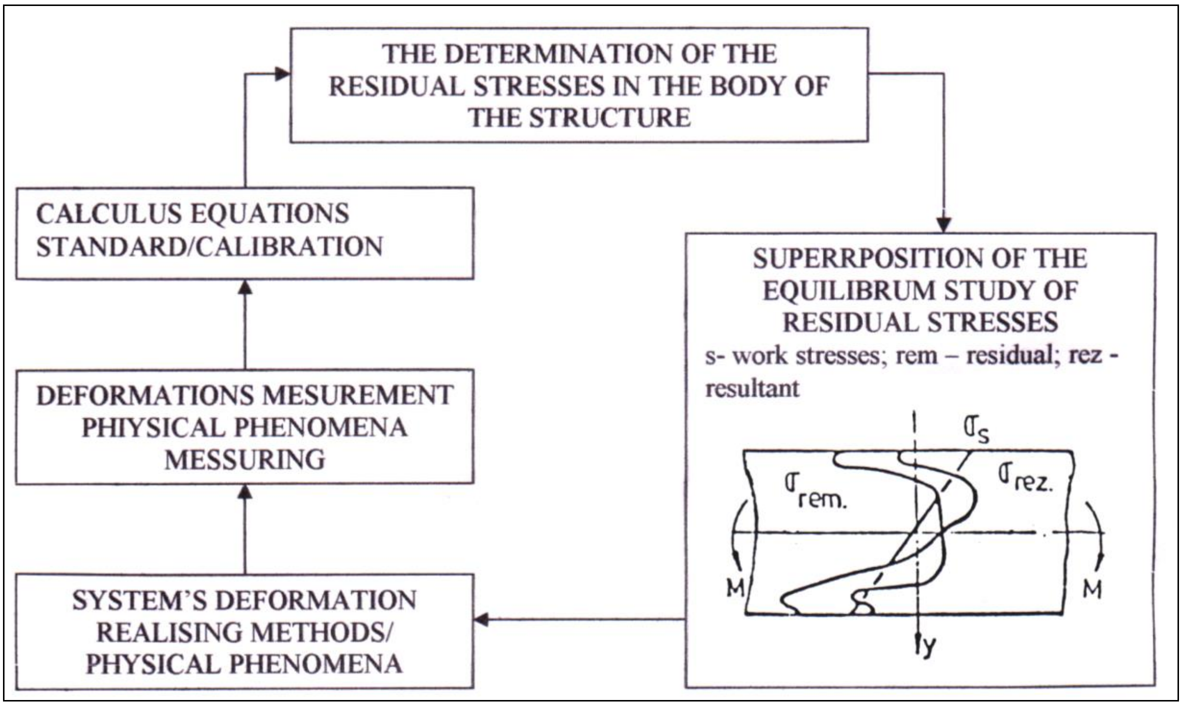

Figure 1. The technique of determination of residual stresses in the body of structure

The mechanical methods take into consideration a homogenous and isotopic material. At the composite material, galvanic covers, ceramics etc. we must also consider the anisotropy. There were developed theoretical techniques of the mechanical ways of application at the materials that are not homogenous. The calculus based on the finite element method can lead to the results that are useful in the consideration of the anisotropy (many parameters, which means different material combination and the anisotropy of the material features). The mechanical methods are not subjected to any restriction of material. It must be correctly applied the technique of evaluation and the material's features. In contrast with the x radiation diffraction method, we can measure the residual stresses from noncristal material.

The request of staff and equipment are generally low. The precision of mechanical methods is of ± 10 N/mm^2 it is due to the needed time for preparing the measuring points, the measuring time being generally longer then in the nondestructive methods.

Table 1.

Shape of surface	*Measurements*	*Measure techniques*	*Methods*
PLANE	- deformations - specific deformations	▪ movement translator - *mechanical* - *electrical* - *optical* ▪ Electrotensiometric resistant translator (TER)	-drilling -turning -blind hole -ring hole -duct/ditch
CURVE	-deformations -boundary -curve	 -Moiré's shadow -Holographic interferometry	-layer removement -duct/ditch

Table 1 presents the measuring examples of the deformation taking in consideration the measuring techniques and the used methods on plane and curve surface.

During the making process (weigh, mechanical process, treatments etc.) in the corps are induced residual stresses these are the basis of dimensional variations, of breakouts in general, and of mostly irrecoverable scraps. The evaluation of residual stresses for their elimination is a peculiar action.

2. THE METHOD OF BLIND HOLE WITH A DEFORMATION WITNESS

The method of blank hole with a deformation witness, proposed by J. Mathar in 1934, remained unchanged until today. Yet today it is applied to a large range of different shaped products, with different improved equipments. The procedure consists in making a circular hole (low diameter) and measuring the deformation produced by realizing the existing tensions. The values permit the calculation of residual stresses. The precision of the method depends mainly by the position of the hole towards the witness, by the way of making the hole and by the measuring technique of the deformation.

The determination of deformation can be done by: special tensiometer rosette, photoelastic covers (polish or thin sheets), fragile covers (braking polish), holographic interferometry, MOIRE fringes (mainly for curve surfaces). In practice the last measuring technique for deformations can't be compared with the resistive electrotensiometer translators due to precision disadvantages, complexity etc.

We mostly use electrotensiometer translators specially made (networks exposed at 0-90-135 or 120), located in correlation with a hole location signal. In this way the centric hole can be done precisely which is essential for the correction of the method

Figure 2 briefly shows the method of blind hole with a deformation witness. The special tensiometers rosettes measure the produced deformations.

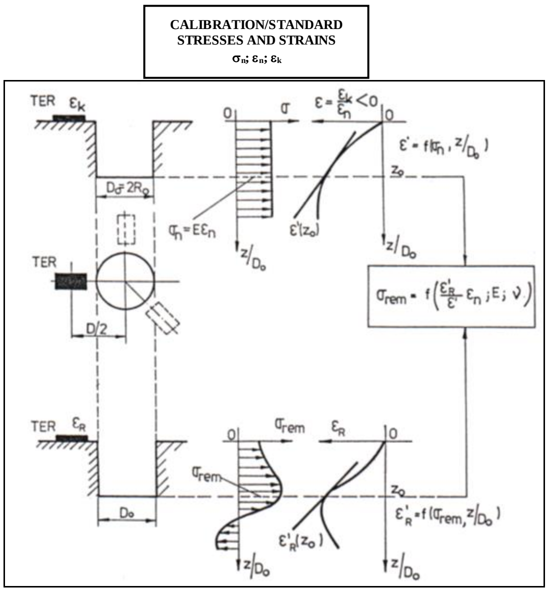

Figure 2. The method of blind hole with a deformation witness

The thickness of the structure's walls differs from case to case, by the time of action. The residual stress grad rents in the nearby areas of the surface (0,01m) can't be generally identified, we can only specify medium values. There is a superior limit of the thickness of the wall. As long as the solid that remains after the action is sufficiently stabile.

Figure 3 compares the depths of the areas measured with different methods, we can see that the analyzed method overcome and many times they become opposed.

The errors that appear when using the blind hole with deformation witness method depend on: the technique of making the hole, the limit's conditions and the tension's grouped in table 2, telling the level of importance/ influence and the request corrections. As the residual stresses are globally evaluated, the mechanical models are capable to determine only the 1st grade residual stresses (macro tensions). The method of the blind hole allows a local action (the hole doesn't have a big surface) and can be influenced by the 2nd grade residual stresses, depending on the border's conditions.

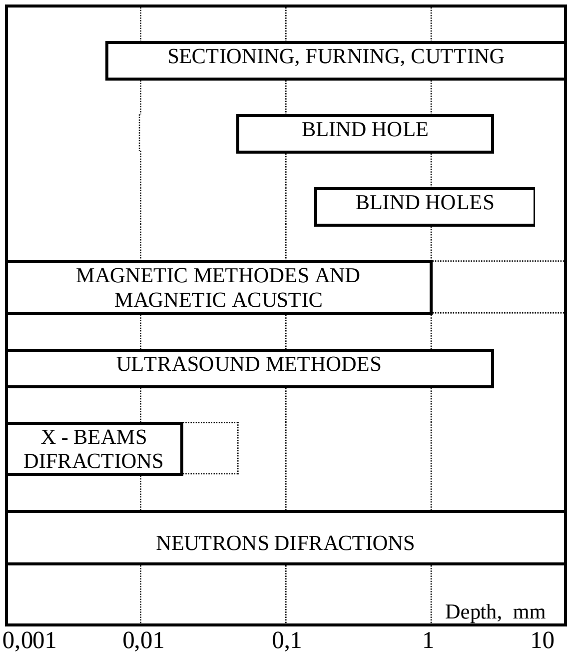

Figure 3. Studied zones by different analysis Methods.

Table 2.

The technique of determination of residual stresses	The modification of residual stresses at the movement of the precise center of the blind hole from the wanted measure point The influence of hole's temperatures	■ ■
Drilling technique	The resulting tensions in the drilling process Deviation from the ideal of the blind hole The eccentrically drilling The imprecise depth and its measurement	■ ■ ■ □ Δ
Limits' conditions	Barring zone influence Nearby hole influence Sizes' influence	□ Δ □ ▲ □ Δ
Tension's conditions	Tensions gradient influence The orientation of the blind hole influence The plastic effect as the growth of the hole outcome (the collar effect in the barring area)	■ ■ □ Δ
Residual stress' determination	The diffusion of the considerate indices and the calibration curves Errors in the system of the tension's gradient calculation of hole's depth	■ □

■ without importance ▲ possible correction
□ considerable influence Δ future development

3. CONCLUSION

General the method of blind hole using as a deformation witness tensiometer rosette specially made and calibrated, is an easily applicable method, used in a practical verification, being sufficiently precise. In USA it is actually the only standard method ASTME 837-85.

In evaluating the residual stresses, the paper propose certain aspects regarding the measurement of deformations, the principle of blind hole with a deformation witness and the errors that occur and same recommendations regarding the techniques of these stresses determination.

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