

# STATIC AND DYNAMIC ANALYSIS IN A DRAW PUNCH DESIGN

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## ABSTRACT

The objectives of this study are :

1. To design a draw punch for the purpose of deep drawing a cylindrical cup.
2. To improve the draw punch design by determining the static and dynamic reliability of the draw punch.
3. To determine the life span of the draw punch under dynamic loading.

A static load is a force which has an unchanging magnitude, unchanging points of applications and unchanging direction. In this study, static analysis was performed using the Finite Element Method. Three different static failure theories namely *Maximum Normal Stress Theory*, *Maximum Shear Stress Theory* and *Distortion Energy Theory* were used to determine the static reliability based on the responses from Finite Element Method tools.

A dynamic load is any load which has a changing magnitude, direction and positions of applications. As such, the responses to dynamic loading such as stresses are also dynamic and varying with time. Dynamic analysis was performed using the Finite Element Method tools. The most significant characteristic of this dynamic analysis is that these dynamic stresses can cause fatigue failures although the actual maximum stress is below the yield strength. Failures have been caused by stresses that have been repeated for a large number of times.

### **List of Symbols :**

$\mu$	coefficient of friction
$F$	punch force
$t$	blank thickness
$D$	blank diameter
$d$	cup diameter
$h$	cup height
$r$	strain ratio
$S_{ut}$	nominal ultimate tensile strength
$u_m$	value of unknowns at nodal points
$N_m$	interpolation functions
$\sigma_y$	stress in y direction
$e_y$	strain in y direction
$v_y$	deformation in y direction
$k$	element property matrix
$q$	vector of unknowns at element nodes
$Q$	vector of element nodal forcing function
$K$	assemblage property matrix
$r$	assemblage vector of nodal unknowns
$R$	assemblage vector of nodal forcing functions
$E$	Young's Modulus Of Elasticity
$S$	stress
$A$	area
$e$	deformation
$\epsilon$	strain
$L$	length
$\sigma$	principal stress
$\tau_{max}$	maximum shear stress

### **List of Symbols**

$S_{yt}$	tensile yield strength
$S_{yc}$	compressive yield strength
$P$	load
$f_I$	inertia force
$f_s$	elastic force
$f_D$	damping force
$v$	displacement
$p(t)$	applied load
$k$	spring stiffness constant
$c$	damping constant
$W$	weight
$S_e$	endurance limit / fatigue limit
$S'_e$	axial endurance limit
$S'_f$	fatigue strength of steel
$S_{uc}$	ultimate compressive strength

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