MODELING OF LEFT OVER STRENGTH IN DRILLING OF COMPOSITE LAMINATES

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INTRODUCTION

- **Fibre Reinforced Plastics (FRP) composites occupy an important place as high performance engineering materials.**
- **Although in most of the fabrication processes used for composites, machining is avoided, sometimes machining of FRP is essential.**
- **Out of various machining processes used for FRP, drilling is the most common machining operation used.**
- **The drilling of holes in FRP composites presents problems different from those encountered in drilling metals.**
- **Problems encountered in drilling of FRP composites are:**
  Crack formation .
  Damage to surface layers (delamination).
  Surface roughness.
  Deviation of hole diameter from nominal diameter (hole shrinkage).
  Roundness error.
- **In the present work, a new concept of Left Over Strength (LOS) is introduced.**

- **A centre hole is drilled in flexural test specimen and flexural load at failure is determined.**
- **The LOS is expressed as percentage of load which the specimen with a drilled centre hole can carry as against the specimen with first hole.**
- **LOS depends upon the quality of hole in the specimen.**
- **As the number of holes drilled using a particular drill increases, quality of hole deteriorates and value of parameters such as thrust, torque and temperature monitored during drilling also increases.**
- **Modeling of LOS using Multiple Regression Analysis is carried out to correlate LOS with thrust, torque and temperature:**

  LOS = K1 (thrust)n1 (torque)n2 (temperature)n3
  For tipped carbide drill : n1=0.7, n2=0.24, n3=0.64 .

LAMINATE MATERIAL

-Glass fibre reinforcement: UD mat (300g/m2).

-Matrix: Epoxy Resin (LY 556) + Hardener (HT 972) , Ciba-Geigy, India.

-Fibre Vol Fraction: 0.40.

LAMINATE LAYUP

(0)n, (0/90)ns, (o/+45)ns, (0/+45/90)ns.

The results of the study are given in Figs 1-3 below:

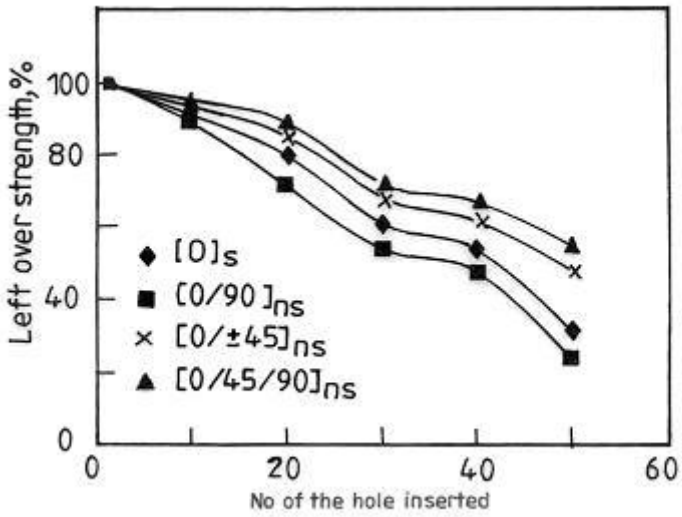

Fig.1 LOS : Effect of Layup

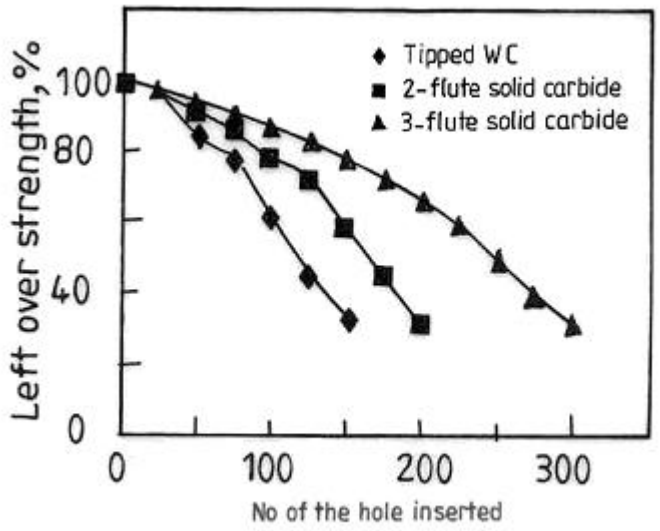

Fig.2 LOS : Effect of Drill Type

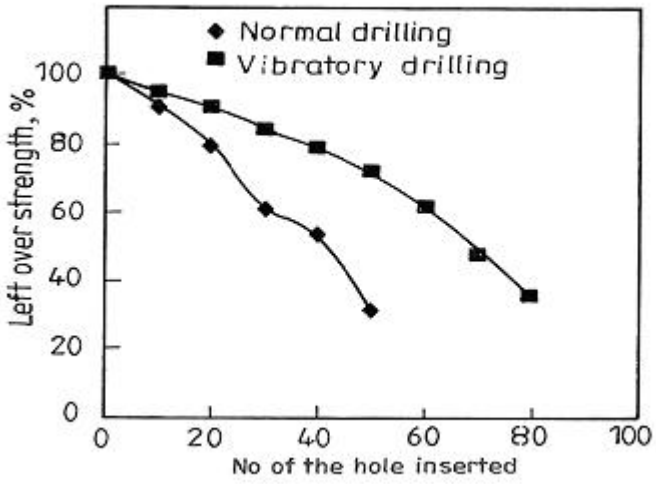

Fig.3 LOS: Effect of Workpiece Vibration

Following observations are made from Fig.1-3 :

1. **Layup (0/+45/90)ns has maximum LOS, so this is the best layup from drilling point of view. (0/90)ns (symmetric crossply) layup is the worst from drilling point of view.**
2. **3-flute solid carbide drill performs better than tipped WC & 2-flute solid cabide drills.**
3. **Workpiece vibration improves the drilling performance of cutting tool.**
