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1 GENERAL INFORMATION

1.1 INTRODUCTION

“Fastener load transfer” tool is used to determine and correctly consider forces transferred through fasteners and bypassing forces in the plate and straps.

There are 4 types of joint configurations available:

1) Single-Shear-Lap Joint (Figure 1);

2) Single-Shear-Hard Point (Figure 2);

3) Double-Shear-Lap Joint (Figure 3);

Fig. 1 - Single-Shear-Lap Joint

Fig. 2 - Single-Shear-Hard Point

Fig. 3 - Double-Shear-Lap Joint
4) Double-Shear-Hard Point (Figure 4);

![Diagram of Double-Shear-Hard Point](image)

Fig. 4 - Double-Shear-Hard Point
1.2 PROGRAM DESCRIPTION

Program contains three tabs:

1) Materials – user can enter isotropic/orthotropic material characteristics (Figure 5);

2) Laminate (Figure 6) – available functions are:
   a) laminate data tabular input (angle, thickness, numbers of layers);
   b) rotate whole laminate for a certain angle (if applicable);
   c) set a laminate symmetry (if applicable).
3) Fastener Load Transfer (Figure 7) – functions are:
   a) set number of fasteners for analysis;
   b) set diameter of fasteners (diameter should be the same for all fasteners);
   c) set plate and straps material;
   d) set plate and straps thickness;
   e) set plate and straps width (width is calculated automatically as W=5*D (fastener diameter));
   f) set bay length (bay length range: 4*D ≤ L ≤ 6*D);
   g) choose type of joint configuration.

Fig. 7 – Fastener Load Transfer
1.2.1 PROGRAM START

To run “Fastener load transfer” tool click the right mouse button and select «Open» (Figure 8). From the File menu (2) choose New Project (3) (Figure 9). From the same menu (File) user can also Load Project or Save Project (3). Information about the tool is available from the About menu (4) (Figure 9). Please, pay attention, that there is no Unit selection available in the program, therefore the User itself defines the unit system to work in.

Fig. 8 - “Fastener load transfer” tool start
Fig. 9 - “Fastener load transfer” interface
1.2.2  **TAB - MATERIALS**

After creating a New Project user can enter the following material data (Figure 10):

1) Name of material;
2) Elastic modulus;
3) Shear modulus;
4) Poisson ratio;

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**Fig. 10 – Materials**
1.2.3 TAB – LAMINATE

The following functions are available in the Laminate tab (Figure 11):

1) Material – User chooses one of the previously created materials (in Materials tab) from a drop-down list for a selected layer, number of the selected material will be automatically written in Mat.Nr. column (2));

2) Material Number (User can enter a number of the previously created materials (in Materials tab), name of the material will be automatically written in Material column (1));

3) User enteres layer orientation;

4) User enteres layer thickness;

5) Total thickness of the laminate is calculated automatically based on the entered thickness of each layer and the total number of layers in the laminate;

6) User can set symmetry for the laminate (if applicable);

7) Layer thickness – changes thickness of all layers to an entered value;

8) Layup rotate – rotates all layers through an entered angle.

Fig. 11 – Laminate
1.2.4 **TAB – FASTENER LOAD TRANSFER**

The following functions are available in the Fastener Load Transfer tab (Figure 12):

1) User chooses type of joint configuration;
2) User chooses fastener material and number of fasteners;
3) User enters diameter of fasteners (diameter should be the same for all fasteners);
4) User chooses plate material (material is the same for all bays);
5) User sets plate thickness (thickness should be the same for all bays);
6) Plate width – is calculated automatically as $W=5*\text{D}$ (fastener diameter);
7) User chooses strap material (material is the same for all bays);
8) User sets strap thickness (thickness should be the same for all bays);
9) Strap width – is calculated automatically as $W=5*\text{D}$ (fastener diameter);
10) User sets bay length (bay length range $4*\text{D} \leq L \leq 6*\text{D}$);
11) User can set fastener layout symmetry;
12) User enters a total Load ($P$) applied to the plate.

![Fig. 12 – Fastener load transfer](image)
1.2.5 LOAD TRANSFER CALCULATION RESULTS

After entering all necessary joint data press Start (1) button to run the calculation of load transfer. Results of fastener load transfer and bypassing forces in the plate and straps are displayed in 2 tables in the lower right corner (2) (The load transferred is displayed in two ways: percentage of the total load transferred and the actual load transferred). In the lower left corner schematic joint configuration is displayed (4).
1.3 LITERATURE


APPENDIX 1

COMPARISON BETWEEN FASTENER LOAD TRANSFER TOOL AND MSC.PATRAN

Single Shear - Lap Joint:

Fastener D = 8 mm;
Width: 8*5= 40 mm;
Plate and strap thickness: 10 mm and 10 mm accordingly;
Bay Length: 40 mm.
Single Shear - Hard Point:

Fastener D = 8 mm;

Width: 8*5= 40 mm;

Plate and strap thickness: 10 mm and 10 mm accordingly;

Bay Lenght: 40 mm.
Single Shear - Lap Joint:

Fastener D = 8 mm;
Width: 8*5= 40 mm;
Plate and strap thickness: 6 mm and 14 mm accordingly;
Bay Lenght: 40 mm.
Single Shear - Hard Point:

Fastener D = 8 mm;
Width: 8*5 = 40 mm;
Plate and strap thickness: 6 mm and 14 mm accordingly;
Bay Lenght: 40 mm.
Double Shear - Lap Joint:

Fastener D = 6 mm;
Width: 6*5= 30 mm;
Plate and strap thickness: 5 mm and 5 mm accordingly;
Bay Length: 30 mm.
Double Shear - Hard Point:

Fastener $D = 6 \text{ mm}$;

Width: $6 \times 5 = 30 \text{ mm}$;

Plate and strap thickness: $5 \text{ mm}$ and $5 \text{ mm}$ accordingly;

Bay Length: $30 \text{ mm}$. 
**Double Shear - Lap Joint:**

Fastener D = 6 mm;

Width: 6\*5= 30 mm;

Plate and strap thickness: 7 mm and 3 mm accordingly;

Bay Lenght: 30 mm.
Double Shear - Hard Point:

Fastener D = 6 mm;
Width: 6*5 = 30 mm;
Plate and strap thickness: 7 mm and 3 mm accordingly;
Bay Length: 30 mm.