CLAIMS

1. A method (1800) of debonding a first layer (404) from a second layer (408), wherein the first layer (404) is bonded to the second layer (408) by an adhesive (410) located between the first layer and the second layers, the method comprising:

inserting (1804) a blade (602) of a cleaving tool (600) between the first layer and the second layers (404, 408), the blade being formed of a flexible material, and during insertion of the blade, the blade flexes from a first shape to conform to a second shape being a curvature of the first layer and the second layer;

applying heat, using a heating component, to a portion of the adhesive to heat the adhesive to a pre-determined temperature;

exerting (1806) a controlled force on the cleaving tool (600) to move and flex the cleaving tool from the first shape to the second shape that conforms to the shape of the curvature of the first layer and the second layer, so as to de-bond the first layer and the second layers (404, 408) in a region that includes the heated portion of the adhesive, wherein the controlled force exerted is controlled set to match a de-bonding force calculated for the region based on the pre-determined temperature to which the adhesive is heated; and

upon the movement of the cleaving tool stooping due to the calculated controlled force being less than a force required to move the cleaving tool, maintaining the calculated controlled force while continuing to apply heat to the portion of the adhesive, such that the cleaving tool resumes movement upon the adhesive reaching the pre-determined temperature and the controlled force being at least equal to the force required to move the cleaving tool.

2. The method (1800) of claim 1, wherein the controlling and exerting the controlled force exerted is performed by a control system (706) including one or more processprocessorssing units.

3. The method (1800) of claim 2, wherein the cleaving tool (600) is mounted on a robot (700), and wherein the robot (700) performs the controlling and exerting of the controlled force on the cleaving tool (600).

4. The method (1800) of any preceding claim, wherein the adhesive (410) weakens when heated, the method (1800) further comprising placing (1802) a heating component (610) so as to heat a portion of the adhesive (410) to a set temperature, and wherein the de-bonding force calculated for the region is calculated using the set temperature as the temperature of the adhesive, and wherein optionally the heating component (610) moves with the cleaving tool (600).

54. The method (1800) of claim 41, further comprising varying input power to the heating component (610) in order to maintain a pre-determined temperature, T_d, on a surface of the first layer (404), and wherein optionally the pre-determined temperature of the surface is equal to the set temperature for of the adhesive (410).

65. The method (1800) of any preceding claim 1, wherein the calculated debonding force is a function of position along the first layer and the second layers (404, 408), and wherein the

controlling of the force on the cleaving tool ~~(600) comprises~~ includes adjusting the exerted force as the cleaving tool ~~(600)~~ moves.

~~7~~6. The method ~~(1800)~~ of ~~any preceding~~ claim 1, wherein the first layer ~~(404)~~ is a metallic layer and the second layer ~~(408)~~ is a carbon fibre reinforced polymer layer.

~~8~~7. The method ~~(1800)~~ of ~~any preceding~~ claim 1, wherein the first layer ~~(404)~~ is a wing ~~(404)~~ of leading-edge metalwork ~~(401)~~ of a fan blade ~~(400)~~ and the second layer ~~(408)~~ is a composite portion of the fan blade ~~(400)~~.

~~9~~8. The method ~~(1800)~~ of ~~any preceding~~ claim 1, wherein the exerting the force on the cleaving tool ~~(600)~~ to move the cleaving tool ~~comprises~~ includes pulling the cleaving tool ~~(600)~~ by a handle ~~(606)~~ of the cleaving tool ~~(600)~~.

~~10. The method (1800, 1900) of any preceding claim, further comprising, if or when the movement of the cleaving tool (600) stops due to the calculated force being less than force required to move the cleaving tool, either:~~

~~(i) maintaining the calculated force; or~~

~~(ii) removing the calculated force, and re-trying (1902) movement by re-applying the calculated force after a predetermined time interval.~~

~~11. A cleaving tool (600) arranged to debond a first layer (404) from a second layer (408), wherein the first layer (404) is bonded to the second layer (408) by an adhesive (410) located between the first and second layers, the cleaving tool (600) comprising:~~

~~a wedge-shaped member (604) having a narrower forward region and a wider rear region, and a blade (602) located on the narrower forward region, the wedge-shaped member (604) being arranged to be inserted between the first and second layers (404, 408) and having a first side region and a second side region opposing the first side region with the blade (602) extending therebetween;~~

~~a handle (606) connected to the first and second side regions of the wedge-shaped member (604) and comprising a gripping portion (606a) located forward of the blade (602) and arranged to be gripped to pull the tool (600); and~~

~~a heating component (610) arranged to heat a portion of the adhesive (410) forward of the blade (602) to a set temperature to soften the adhesive (410), the heating component (610) being mounted on the cleaving tool (600) so as to be biased towards the portion of the adhesive (410) to be heated.~~

~~12~~9. A cleaving tool ~~(600)~~ arranged to debond a first layer ~~(404)~~ from a second layer ~~(408)~~, wherein the first layer ~~(404)~~ is bonded to the second layer ~~(408)~~ by an adhesive ~~(410)~~ located between the first layer and the second layer~~s~~, the cleaving tool ~~(600)~~ comprising:

a blade ~~(602)~~ arranged to be inserted between the first layer and the second layer~~s~~ ~~(404, 408)~~, the blade being formed of a flexible material, and during insertion of the blade, the blade flexes from a first shape to conform toa second shape being a curvature of the first

layer and the second layer; ~~and~~

control circuitry ~~(706)~~ arranged to exert a set controlled force so as to move the blade ~~(602)~~ so as to de-bond the first layer and the second layer~~s~~ ~~(404, 408)~~ in a region that includes the heated portion of the adhesive, ~~wherein~~ the controlled force exerted ~~is controlled~~being set to match a de-bonding force calculated for the region based on the pre-determined temperature to which the adhesive is heated, and upon the movement of the cleaving tool stopping due to the calculated controlled force being less than a force required to move the cleaving tool, the calculated controlled force is maintained while continuing to apply heat to the portion of the adhesive, such that the cleaving tool resumes movement upon the adhesive reaching the pre-determined temperature and the controlled force being at least equal to the force required to move the cleaving tool.

~~13~~10. The cleaving tool ~~(600)~~ of claim ~~12~~9, further comprising a heating component ~~(610)~~ arranged to heat a portion of adhesive ~~(410)~~ to ~~a~~ the set temperature at which the adhesive ~~(410)~~ softens, and wherein the de-bonding force calculated for the region is calculated using the set temperature as the temperature of the adhesive.

~~14~~11. The cleaving tool ~~(600)~~ of claim ~~12 or claim 13~~9, further comprising a wedge-shaped member ~~(604)~~ having a narrower forward region ~~and~~ relative to a wider rear region, ~~and wherein~~ the blade ~~(602) is~~ being located on the narrower forward region of the wedge-shaped member ~~(604)~~, and ~~wherein optionally~~ the wedge-shaped member ~~(604)~~ has an angle of between 3° and 30°~~, and optionally around 7°~~.

~~15~~12. The cleaving tool ~~(600)~~ of ~~any of~~ claim~~s 11 to 14~~9, wherein the cleaving tool ~~(600)~~ is arranged to be mounted on, and moved by, a robot ~~(700)~~.

~~16~~13. The cleaving tool ~~(600)~~ of ~~any of~~ claim~~s 11 to 15~~9, wherein the blade (602) has a thickness less than a thickness ~~that~~ of the adhesive ~~(410)~~, and ~~optionally~~ the blade is serrated.

~~17~~14. A debonding assembly ~~(1100)~~ arranged to debond a first layer ~~(404)~~ from a second layer ~~(408)~~, wherein the first layer ~~(404)~~ is bonded to the second layer ~~(408)~~ by an adhesive ~~(410)~~ located between the first layer and the second layer~~s~~, the debonding assembly ~~(1100)~~ comprising:

a cleaving tool ~~(600) comprising~~ including a blade ~~(602)~~ arranged to be inserted between the first layer and the second layer~~s~~ ~~(404, 408)~~, the blade being formed of a flexible material, and during insertion of the blade, the blade flexes from a first shape to conform to a second shape being a curvature of the first layer and the second layer;

a robot ~~(700)~~ arranged to move the cleaving tool ~~(600)~~ so as to de-bond the first layer and the second layer~~s~~ ~~(404, 408)~~ in a region that includes the heated portion of the adhesive; and

a control system ~~(706)~~ arranged to control the robot ~~(700)~~ to exert a set controlled force on the cleaving tool ~~(600)~~ to move the cleaving tool ~~(600)~~, ~~wherein~~ the controlled force exerted ~~is~~ being ~~controlled~~ set to match a de-bonding force calculated for the region based on a pre-determined temperature to which the adhesive is heated, and upon the movement of the cleaving tool stopping due to the calculated controlled force being less than a force required

to move the cleaving tool, the calculated controlled force is maintained while continuing to apply heat to the portion of the adhesive, such that the cleaving tool resumes movement upon the adhesive reaching the pre-determined temperature and the controlled force being at least equal to the force required to move the cleaving tool.

~~18~~15. The debonding assembly ~~(1100)~~ of claim ~~17~~14, wherein the cleaving tool ~~(600) further comprises~~includes a heating component ~~(610)~~ arranged to heat a portion of the adhesive ~~(410)~~ to ~~a set~~the pre-determined temperature to soften the adhesive ~~(410)~~, and wherein the de-bonding force calculated for the region is calculated using the set temperature as the temperature of the adhesive ~~(410)~~.

~~19~~16. The debonding assembly of claim ~~18~~15, further comprising a power supply configured to provide varying input power to the heating component in order to maintain a pre-determined temperature~~, T_d,~~ on a surface of the first layer, and wherein ~~optionally~~ the pre-determined temperature of the surface is equal to the ~~set~~ pre-determined temperature for the adhesive.

~~20~~17. The debonding assembly ~~(1100)~~ of claim ~~19~~16, wherein the calculated debonding force is a function of position along the first layer and the second layer~~s (404, 408),~~ and ~~wherein~~ the controlling the force on the cleaving tool ~~(600) comprises~~ includes adjusting the