A PROPOSAL OF STRESS/STRAIN ANALYTICAL PROCEDURE OF TEXTILE COMPOSITES WITH STITCH BY M³ METHOD

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INTRODUCTION

There are many kinds of the textile composites such as a woven fabric, a knitted fabric, a braided fabric, a stitched fabric etc. The architectures of these textiles are not so simple.

As the stitched yarn with a knot has more complicated pattern, the coordinate system is also very intricate. Therefore, finite element modelling of textile composites is very difficult. The penetration of yarns may be occurred when the conventional software allies to determine the architecture of yarns. In addition, it is very important to make clear not only the stress state but also the damage occurrence in composites in order to estimate the reliability for structures.

To meet the above items, we’ve developed a computer system which can generate a finite element mesh for the complicated pattern with a knot such as stitched yarn. We’ve also developed the computer program of superposition method named M³ which can analyze the stress and strain, and which can simulate the occurrence and the propagation of damage under applied loading based on damage mechanics.

FEM MODEL FOR TEXTILE COMPOSITES WITH A STITCH

The geometrical and mechanical model of textile can be provided by WiseTex, which gives the geometry of centreline of yarns. The mesh generation for textile composites with stitch by using WiseTex and MeshTex are shown in Fig.1. It is recognized that the precise FEM model is generated in process of technique and development of software.

We have employed the computer software called WiseTex to solve the architecture of textile. We have the stitched laminate composites as a typical example of textile composites. The stitched yarn has a complicated pattern with a knot. The coordinate system of stitched yarn is also very intricate. The mismatch of nodal points between the stitched yarn and lamina occurs. Therefore, the mesh generation of these materials is quite difficult. The approach to solve the problems by superposition has been developed.

The FE meshes of laminate and the stitched yarn are generated individually. When the penetration occurs in stitched yarn due to knot, it can be solved by the change of the cross-section near the knot as mentioned above. The proposed method has been applied to stitched laminate composites. Fig 1 shows the result which has been obtained from above procedure. Fig.2 shows the numerical result of stress distribution when the strain of 1% is applied in X-direction. The stress and strain have been analyzed by SACOM.
CONCLUSION

We’ve developed the computer system which consists of the mesh generation, the analysis for stress/strain and the simulation of damage propagation. A typical numerical example has shown to demonstrate the effectiveness of the system. At first, the FE meshes generating procedure for various textile composites with complex architecture have been described. Then, a numerical procedure which the damage propagation can simulate has been described. From numerical results, it is recognized that the developed system is very useful as simulation tool of mechanical behaviours for several of textile composites.

REFERENCES
