APPENDIX A

PROGRAM FLOW CHARTS

LIST OF FIGURES

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In this appendix, a variety of flow charts are presented to show the relationship of the Reflection Cracking Design Model developed in the NCHRP 1-41 Project to the MEPDG software and then to show how the internal calculations are routed within the program. A third set of flow charts show how the calibration program has been organized which allows an agency to develop its own set of model calibration coefficients. The MEPDG program is organized generally as shown below in Figure A-1.

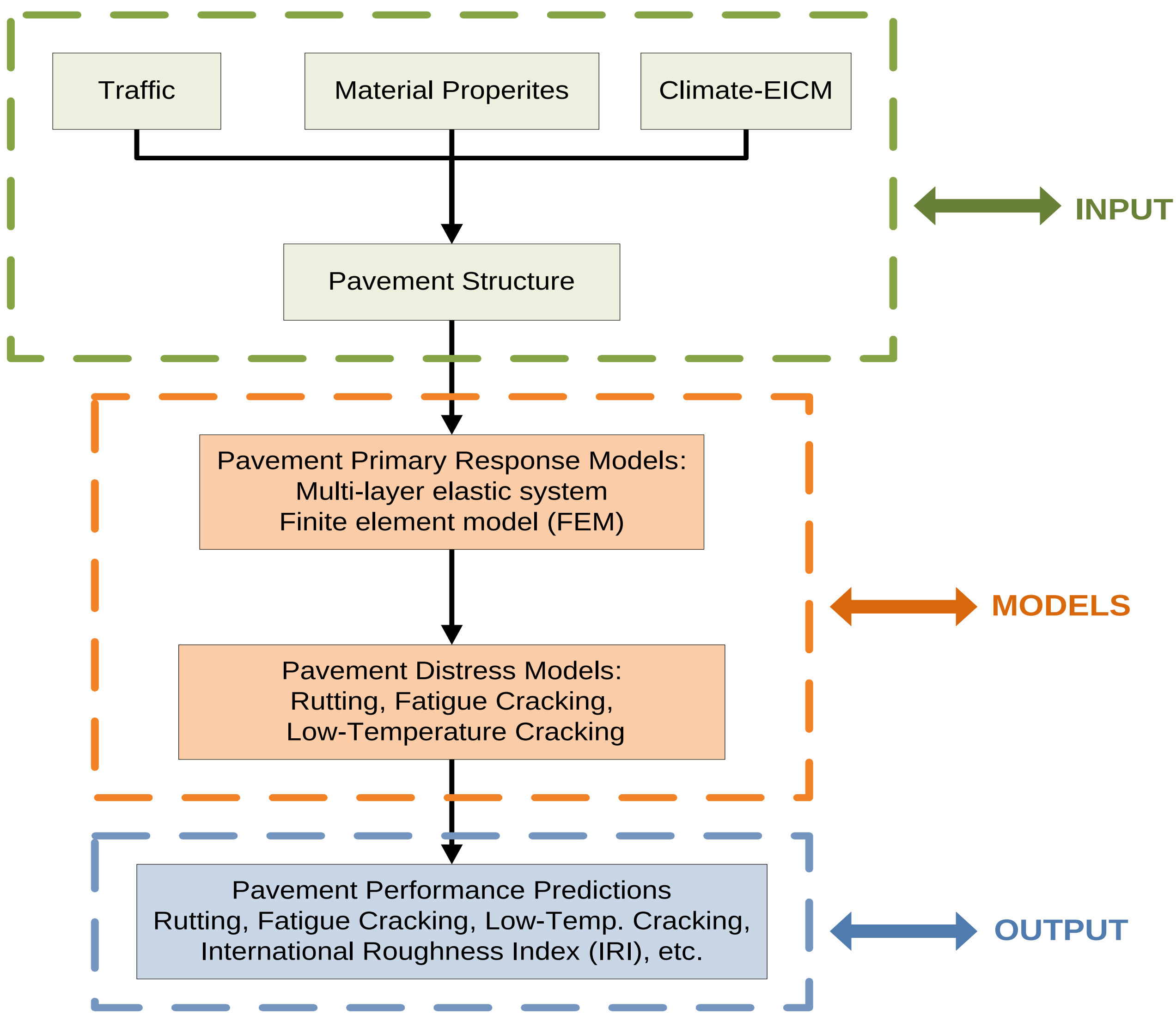

Figure A-1. Structure of the MEPDG software.

The relationship between the MEPDG Design software and the Reflection Cracking Design software developed in this NCHRP 1-41project is shown in the following Figure A-2.

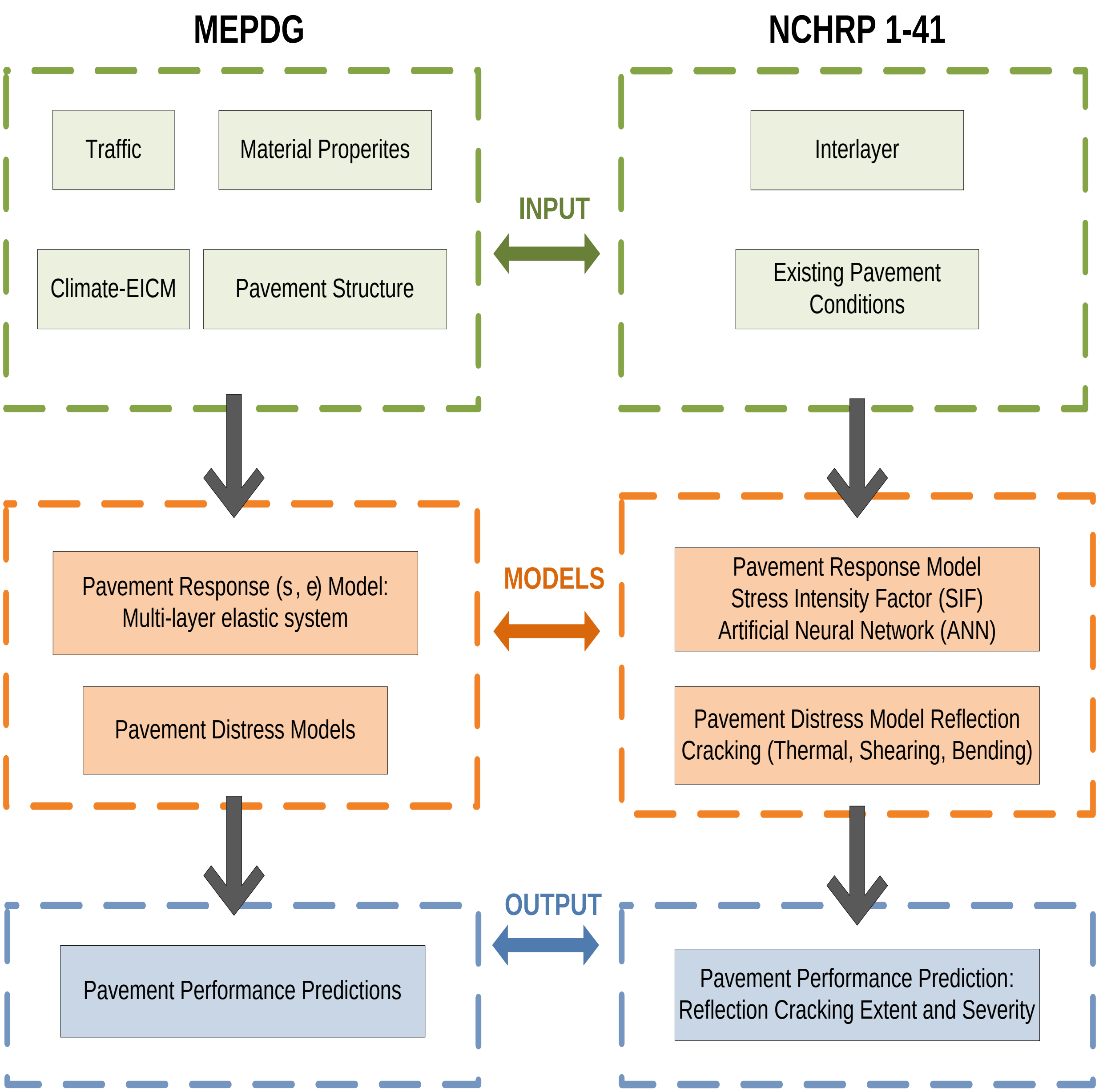

Figure A-2. Relationship of the reflection cracking design program of this project to the MEPDG design software.

The Reflection Cracking Design (RCD) program is intended to be used as a subprogram to the MEPDG software. It takes the same types of traffic, material property, pavement structure and climate input as does the MEPDG but requires additional information concerning the current condition of the existing pavement and the mix design and thickness of the proposed overlay. Whereas the MEPDG has a multi-layered elastic primary response model to compute the stress, strains and deflections in the original pavement, the RCD program uses Artificial Neural Network algorithms to calculate the growth of cracks up through an overlay. The pavement distresses that are predicted in the MEPDG are rutting, fatigue cracking and low-temperature cracking whereas the RCD focuses upon the three separate mechanisms of thermal, bending, and shearing that cause transverse reflection cracking. The performance predictions produced by the RCD program are graphs of the expected rise of the low, medium and high severity levels of the transverse reflection cracking.

As with the MEPDG, in which the user can choose to input data at three different levels of detail, the same holds true for the RCD program. The input information on the existing pavement condition can be detailed information from cores, field observations of crack spacing and severities and layer moduli backcalculated from nondestructive deflection testing or can be assumed entirely from the user's experience. The user can input the job mix formula for the overlay and the six detailed characteristics of a binder used in the CAM model (Level 1) or can put in the mix design and the Performance Grade of the binder (Level 2) or can put in the mix design and let the program use an internally tabulated characteristic binder for the climatic region in which the proposed overlay will be built (Level 3).

The three crack growth mechanisms are illustrated in Figure A-3. This figure also shows the pavement structure that must be input to the RCD program and the assumed growth pattern of the reflection cracks. It is assumed that the cracks initiate above a crack or joint in the old pavement surface layer. The higher stresses at the overlay surface that are due to the lower temperature at that location are taken into account in the finite element computations that were made in developing the thermal Artificial Neural Network stress intensity factor algorithms.

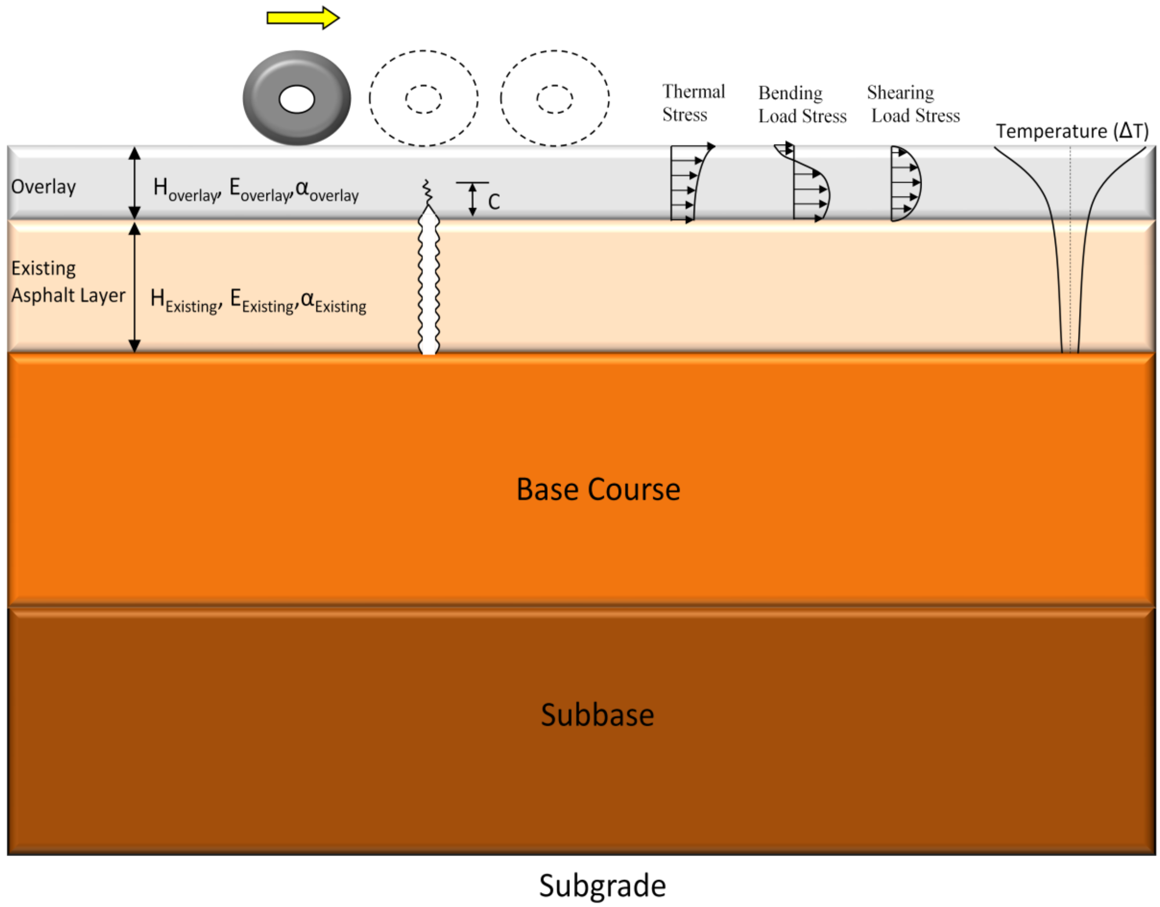

Figure A-3. The three crack growth mechanisms that cause reflection cracking.

The flow charts for each of the three crack growth mechanisms are presented in Figures A-4 through A-6

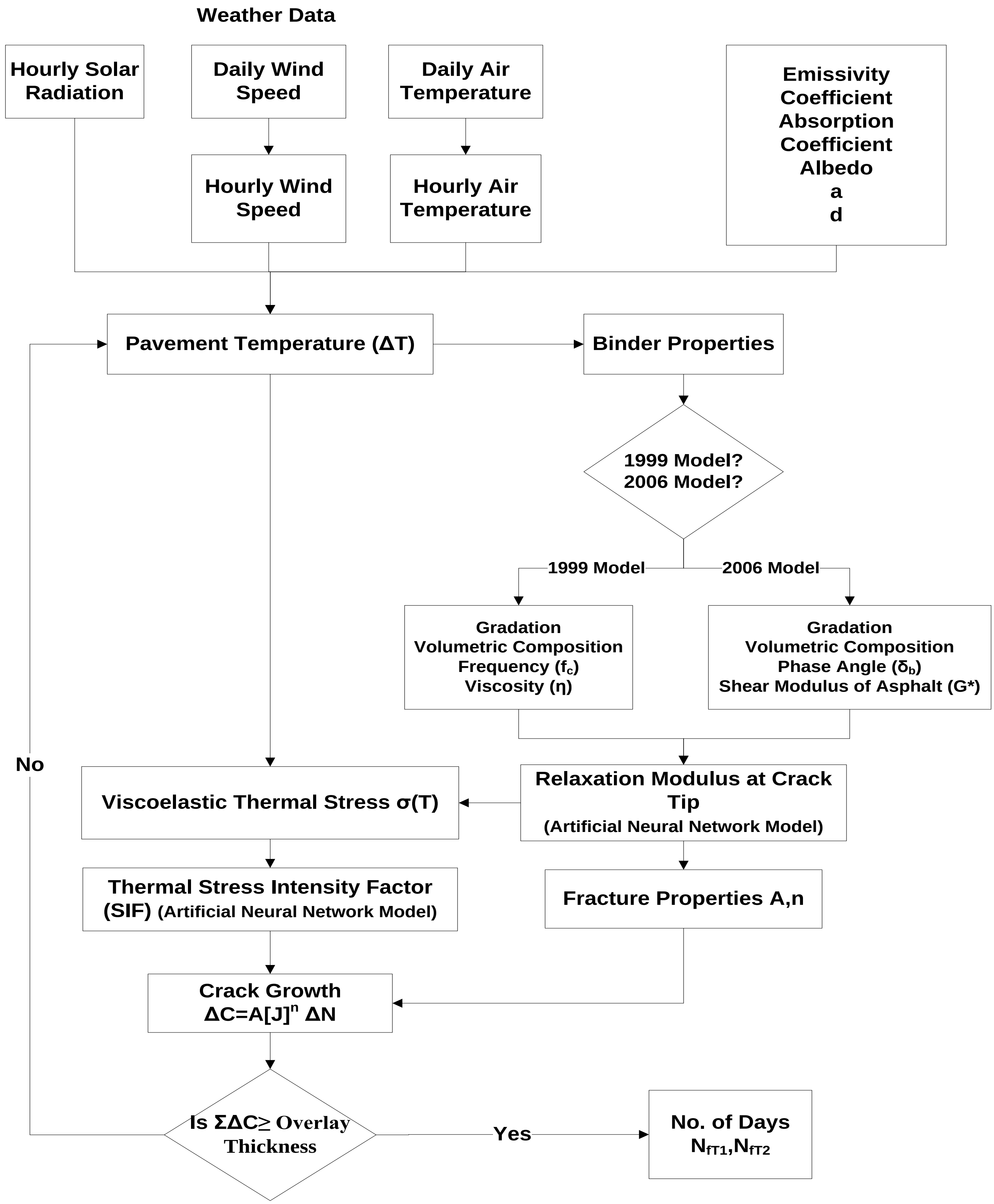

Figure A-4. Flow chart of the thermal crack growth mechanism.

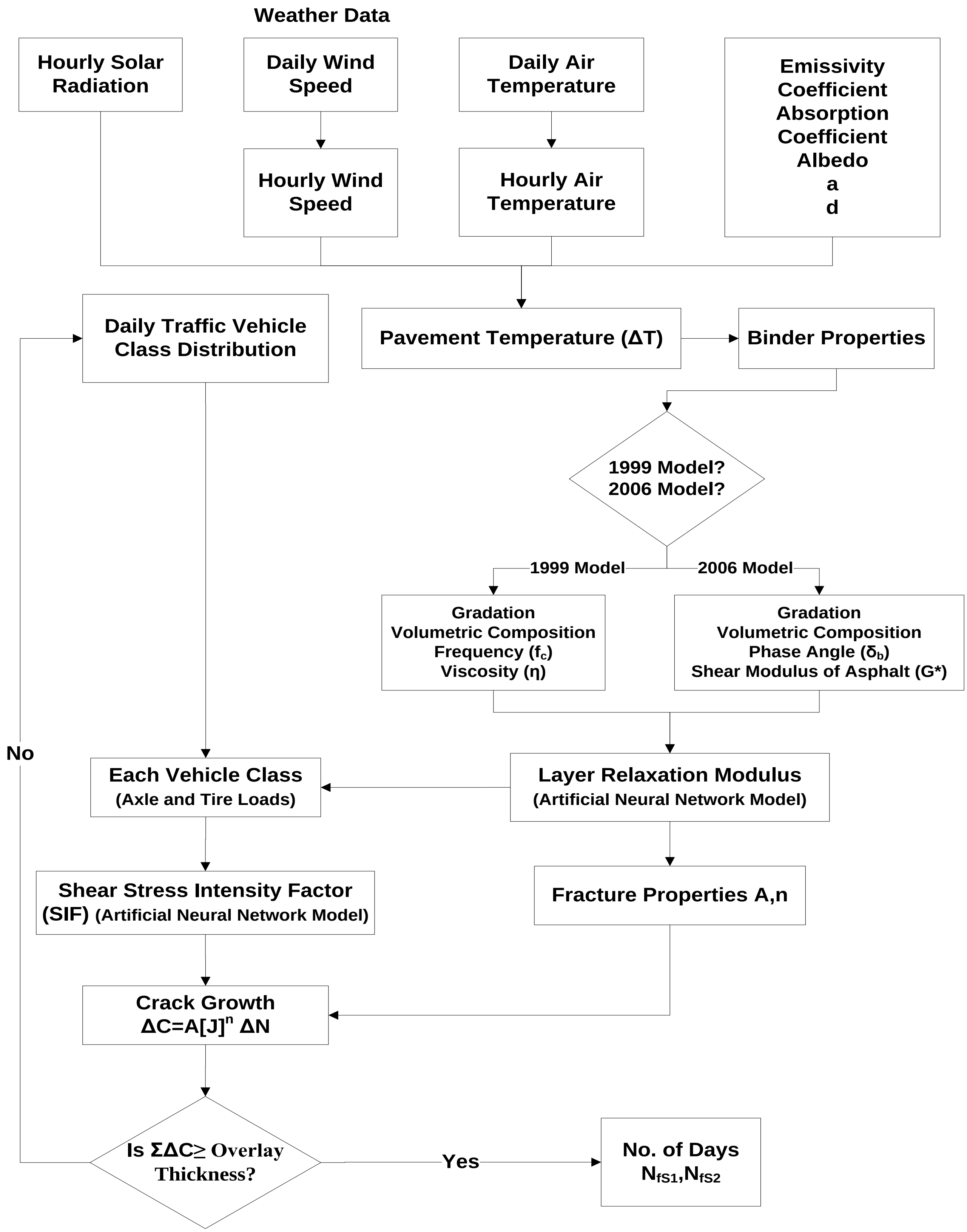

Figure A-5. Flow chart of the shearing crack growth mechanism.

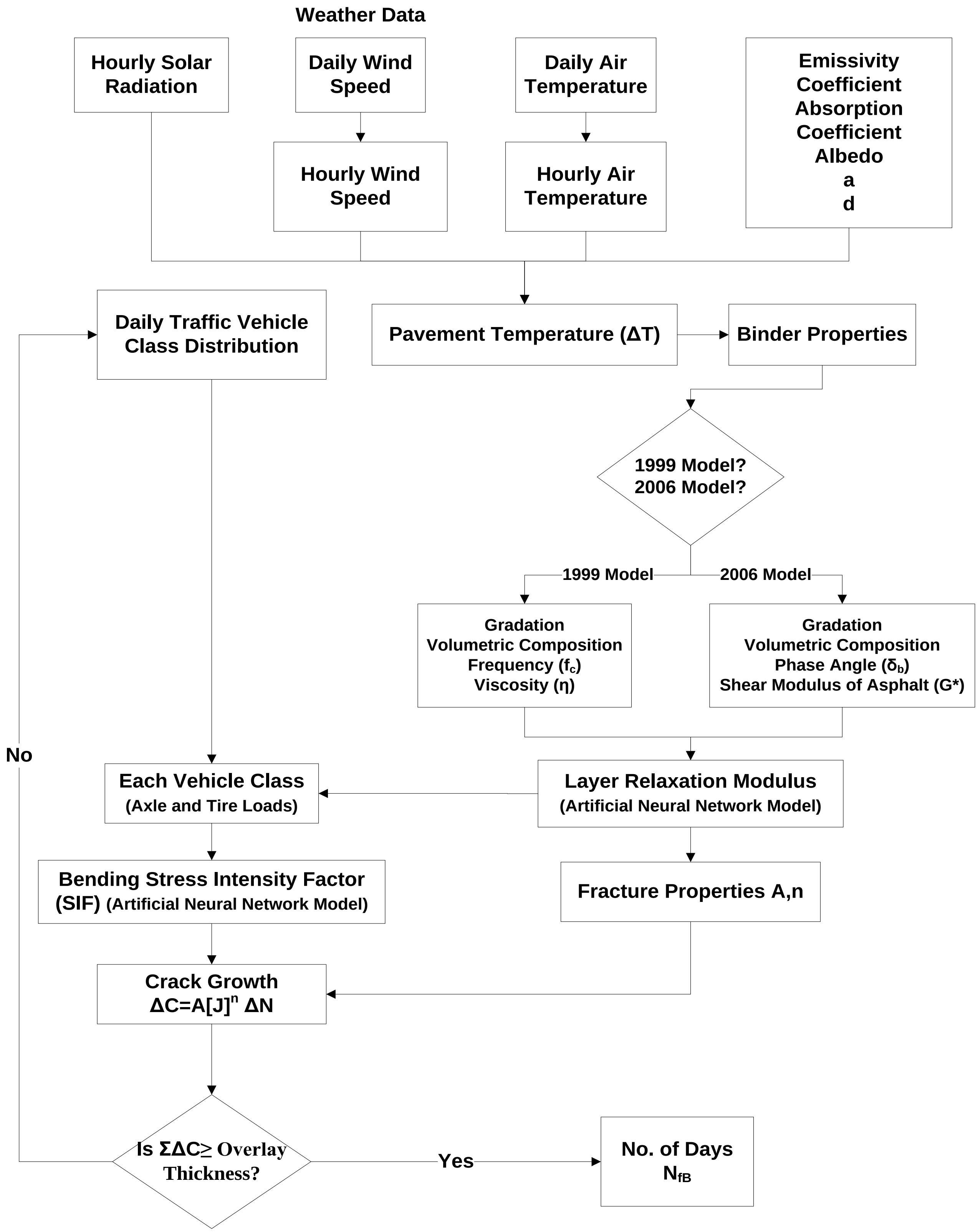

Figure A-6. Flow chart of the bending crack growth mechanism.