The fundamental equations for the theoretical treatment of wood during the process of pyrolysis are presented in Chapter 1. Expressions which must be specially introduced for combustible materials are those which describe the pyrolytic reaction and reactions at the surface of the material. The reactions are assumed to conform to first order Arrhenius functions.

The treatment also includes the variation in heat capacity and thermal conductivity as a function of the decrease in density due to pyrolysis. When pyrolysis commences, an internal convective flow is set up which affects heat transfer both inside the material and at the surface of the material. The numerical solution is carried out by the finite element method using the computer program WOOD1 written in FORTRAN 77.

The heat balance equation is solved incrementally by the forward difference method, and the critical time increment is calculated successively for each computation stage. In view of the nature of the problem, with rapid reductions in density in the pyrolysis zone, internal convective heat flow and boundary elements which diminish in size, it is necessary to employ both small elements and short time increments in the computations. The calculations are compared with experiments, but the paucity of well defined pyrolysis tests is evident. There is also a shortage of relevant material data, particularly at elevated temperatures, and the scatter in the reported kinetic constants is extremely large (10), (11).

The comparison between calculated and measured temperature distributions shows that it is essential to take moisture content into consideration, and also that further development of the model for wet wood is important. It is evident from the parametric study which has been carried out that the conductivity of carbon and the rate of reaction at the surface of the material have great significance for the depth of charring. It follows from this that it is important for these material properties to be better elucidated and for knowledge concerning surface reactions to be improved. ... This computer program has been developed primarily as an aid in research, but, if computation times can be appreciably reduced, it can also be used for design calculations.