Heat of combustion, fire load and other "strange" terms

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Heat of combustion and fire load: how are these values determined and how are they used?
The questions we receive on the subject are very frequent.
In order to understand what we are talking about, let's start with some main definitions

***Heat of combustion**: Thermal energy produced by combustion of unit mass of a given substance.*
There are two type of values: gross Heat of combustion, and net Heat of combustion: the lower value is taken as the reference value. Normally the Heat of combustion is expressed in MJ/kg (megajoule per kilogram) but sometimes also in MJ/m^3.

***Fire load**: quantity of heat which could be released by the complete combustion of all the combustible materials in a volume, including the facings of all bounding surfaces.*
It is expressed in MJ.

***Fire load density**: fire load per unit area.*
The typical units are MJ/m^2

How is the heat of combustion determined?
It is determined by using the test method EN ISO 1716, also called "calorimetric bomb", which can be performed at CATAS. Another option is to use the bibliographic data published in the technical literature.

What is the purpose of calculating the fire load?
In the design of a large building it is important to divide it into fire compartments or into portions of the building bounded by products and construction elements suitable to ensure, under the action of fire and for a given period of time, fire resistance. It is therefore necessary to avoid that, in the event of a fire, this spreads to the contiguous compartments before the intervention of the Fire Brigade.
The greater the quantity and the "dangerousness" of combustible materials present in a given compartment, the greater the fire resistance of structural elements (walls, floors, pillars, etc.) and not structural ones (doors, partitions, etc.).

Who must calculate the fire load?
The designer of the building.

What information does the manufacturer of a finished product have to provide to the building designer?
The nature and quantity of the components of the finished product. For example, in the case of a padded piece of furniture, it is likely that there are structural parts made of wood and wood based panels, polyurethane foam padding materials, fabric or leather upholstery or faux leather, etc.
For each of these components, the manufacturer must state what they are made of and the quantity, expressed in kg, present in the finished product.
The determination of the net Heat of combustion of the individual components should be the task of the desi-

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gner but often the request is asked to the manufacturer.

How important is it to precisely define the Heat of combustion value of a material?

During the design phase, an estimate is made of the quantities of materials and products that will be present in the individual compartment of the building, therefore an extremely accurate calculation is not required. For this reason the tabulated values, that some experts have collected in industry publications, are widely used

For example, the values ascrivable to the materials of an upholstery furniture can be the following:

- fabrics: 17 ÷ 25 MJ/kg;
- artificial leather: around 22 MJ/kg;
- leather: around 21 MJ/kg;
- expanded polyurethanes: 23 ÷ 28 MJ/kg;
- particle board (density: 600 kg/m^3): approximately 9 MJ/kg;
- compensated panels (density 300 kg/m^3): around 17 MJ/kg;
- wood species: 17 ÷ 22 MJ/kg;
- polypropylene: 40 to 46 MJ/ kg;
- polyamide (nylon): 31 ÷ 34 MJ/kg;
- polycarbonate: about 31 MJ / kg;
- ABS: about 38 MJ/kg.

Sometimes the values are expressed in kilocalories per kilogram (kcal/kg). 1 MJ equals 238 kcal.

In the technical literature there are also tables that provide data on the hypothetical quantity of heat produced by the combustion of complete articles. Since the products are described in a very general way, the declared values must be considered as purely indicative. Some examples:

- unpadded chair: 67 MJ/piece;
- armchair: 335 MJ/piece;
- sofa: 837 MJ/piece.

In fact, they can be useful only to compare them with the values that have been obtained through calculations and considering the individual components of the piece of furniture.

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