1. INTRODUCTION
A central part of the Ph.D. study deals with a generally useful method, that is in process of being developed. The aim is to refine the method so as to assure and control the quality of the design and choice of materials for building components, component system and whole buildings.
The method is to be used by building owners, users, architects, engineers and manufactures in decision-making processes early in the programming stage and later during design.

One of the objectives of Ph.D. study is to create a better understanding of ecological cycles and decisions based on quality and comprehensive assessments in the building sector for heightening the quality of architecture and protect humans and nature against exploitation of resources.

One of the objectives of the Ph.D. study was to prepare a State-of-the-Art, “Architectural and Technical Possibilities with new Building Components” (Andersen, 2002), that deals with a quality assessment of a series of new and well known building components and systems as well as buildings. The assessed components are primarily based on components and systems in renewable materials, but it is also important how these law technology components, mainly plant based components, can be combined and integrated with more traditional high technology components and systems.

2. BACKGROUND
2.1 Global and national strategies
The global aim is to reduce the CO₂ emissions for to counteract the greenhouse effect.
In Denmark shorter building processes and higher quality than today and lower price are demanded.
It is the intention that architects together with the building industry are to develop and design industrialised building components with the purpose of simplifying the building process and make it more efficient (The Ministry of Housing, 2000).

2.2 Quality, sustainability and overall solutions
It is important that the co-operation not focus exclusively on lower price, at the expense of quality and sustainability. Overall solutions should broadly consider the building actors, so that comfort, health and user consideration are prioritised together with good healthy materials, valid technical solutions and a good indoor climate.
2.3 Life cycle analyses and documentation
Earlier investigations (Andersen & Johnson, 1999) show, that by using Life cycle analyses (LCA) it is possible to reduce the environmental load of buildings by about 55% replacing the 5 building elements and materials, with the most impact without changing the aesthetic and function.
By changing the aesthetic, if is possible to make the building even much more sustainable, but by so doing it may become another building with another signal valency.

2.4 The “real” product and sustainability
On the market today are many different building components of different manufacture, and not all are labelled equally well. Composite building components cannot be separated and disposed of and the glue is not always environmental sound.
Many users demand certified products, the “real” product and good quality. It would be desirable if the manufacturers labelled their product better, so that information about contents, emission of harmful substances, disposal and life cycle could be compared.

3. METHODS
3.1 Quality assessment
My assessment of new and well known building components that enjoy renaissance resulted in a State-of-the-Art (Andersen, 2001). The tested method is how to assess some different primarily plant based building components. The quality assessment takes its point of departure in the following concept:

beautiful, venustas

validity, firmitas usefulness, utilitas

Figure 1 Vitruvius’ Trinity year 0

3.2 Vitruvius’ Trinity year 0
The quality can be defined on the basis of the Roman architect and engineer Vitruvius’ concept of a trinity concerning validity, usefulness and beautiful (firmitas, utilitas, venustas). This concept also applies today in an updated form.

3.3 The updated form of Trinity
The concept is adequate for quality, comprehensive assessment and balance in year 0. The concept was used as object in the method.
A new factor is that global climate changes, CO₂ emissions and emission of harmful substances contribute to the parameters for environmental soundness being included in the original concept form year 0.
Today production methods and rentability are essential for visualising barriers or spreading possibilities. Therefore these parameters have also been added to the methods.
3.2 Themes
The following themes are used in the assessment:

- Architectural possibilities, usefulness and beauty
- Technical properties, indoor climate and validity
- Production, resources and economy

4. DISCUSSION
4.1 Building components and integrated design
There are many ways to design and link building components, but it is essential that building components are useful, durable, valid, beautiful, simple, can be varied and additive in system connections, replaceable etc. to obtain flexibility and individuality in the design process. In addition it is an advantage that environmental leads over the lifetime is small and contribute to a good indoor-climate. New building components contributes with news architectural expression, if they are original and can be designed and integrated in the whole building as units.

4.2 Building components and system connections
Detailed knowledge of the properties of materials the are good preconditions for making the best use of properties from several different materials. By combining materials, building components with maximum performance can be obtained and minimal consumption of materials.

The way that building components are connected and with what, is essential for the properties and the aesthetic of the finished product. The joining of the components can be with gluing, nailing, bolting and jointing etc. This for example not the compressive of strength of the brick alone that is interesting, but rather the system (the brickwork including joints) the properties of which it is interesting to know. In addition the properties of the components in relation to the building properties are essential, where for example the front leaf and back leaf will be connected by headers for stabilizing the wall in the finished building.

5. CONCLUSIONS
The treated components are more or less based on CO₂-neutral raw materials in wood, straw, grasses and plant fibre are found all over the world in plentifully quantities as cheap rest product.

The assessment of treated building components has shown what connections and parallels exist with regard to properties, design qualities a system solutions. The assessment also showed how the design and system solutions can be integrated in whole buildings and other components, and how it is necessary to combine the components with more high tech material and components or surface treated to obtain a certain performance.

5.1 Global renewable resources and valid = rentability
In order to reduce the CO₂ emissions designing and producing more building components based on renewable raw materials that can be procured and disposed of present a great potential. Building components of this type with long lifetimes in addition be profitable in comparison with many traditional building components in the industrialised countries an will meet the population growth and help the housing situation in the developing world.
5.2 Architectural possibilities = design qualities and material properties
The quality assessment shows that there are many good example and opportunities for connection with building components of renewable resources with more traditional high technology components or add plant fibres in materials like concrete, clay or plastic. This will give a better performance and new potential forms and new surface characters can be obtained.
When properties, material combinations and form can be choiced, it is possible to vary the performance and design impression depending on use and function. There is a possibility for designing a type of component that can be varied in proportion to a given neighbour and designs of whole systems that can join in neighbourhood with other systems.
Moreover, there are possibilities for designing products with a surface character depending on their use and individual aesthetic wishes. With time ages gracefully depending on use wood sort and the surface treatment. Plant fibres come in many different designs, sizes and colours can also be died.

5.3 Inherent properties and correct use = beautiful design
Wood for example has very differentiated inherent properties that contribute to its many applications and beautiful architecture. Wood can be carved in different dimensions and used to primary building parts, as building elements or bricks. The design qualities of wood can be used to aptering and furniture. By heating it is possible to bend and fold. Moreover it can be defibrated and used as reinforced fibres or as fill in fibre concrete and bricks of clay.

5.4 Technical properties, indoor climate and validity
Most of the investigated building components have good, documented technical properties like for example strength, lightness and insulating properties, but they are not to outside climatic impact such as moisture and ultraviolet rays. By correct use, treatment and maintance can the validity of for example facade claddings be extended.
Some types of material like wood or clay, have natural good moisture and indoor climate regulating properties.
Plant fibre components and straw composites are good alternatives to plastic components. Assuming that they are moisture resistant there are many possibilities for designing new light building components with great strength that can be disposed of. USA and Germany in the front in the car industry with components of this type.

6. PERSPECTIVES
The assessment has show that if the choice of material is included into the early in the design process it making design integrated qualities, but choosing materials to late it becomes pure technical. When the aim is to design optimal building components, it is early in the decision-making process some that qualitative choice need to be made.
Therefore a more refine method than the one used in the State-of-the-Art. The method ought to be more specific and progressive in relation to obtain optimal components, to assure and control the quality of the design in the design and solution processes. A method indicating specific “open” choices, for certain levels in the design and decision process with as well sensed as perceived the measure parameters. At a later stage the fewer possibilities exist for marking the finished product.
6.1 Usefullnes, validity and beauty = Vitruvius updated
The refined method should assist in the choice of material, building components and properties so that the best for a specific use, validity and beautiful is obtained to heighten the quality and sustainability of the buildings.

6.2 Guideline in the beginning of decision phases
Based of the quality assessment (State-of-the-Art) it is the meaning to establish a general refined method for:

1. Building owners, users, architects and engineers when selecting building components for a whole house at the beginning of the design phases in a building project, where the most decisions are made and later in connection with project design.

2. To initiate and/or adjustment of new building components and systems by manufactures.

7. REFERENCES:
