

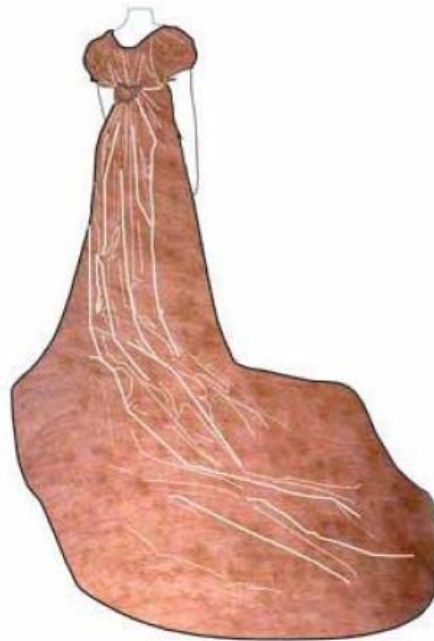
Research proposal

For

The structural behavior of skin related to the structure of the fibers.

Introduction:

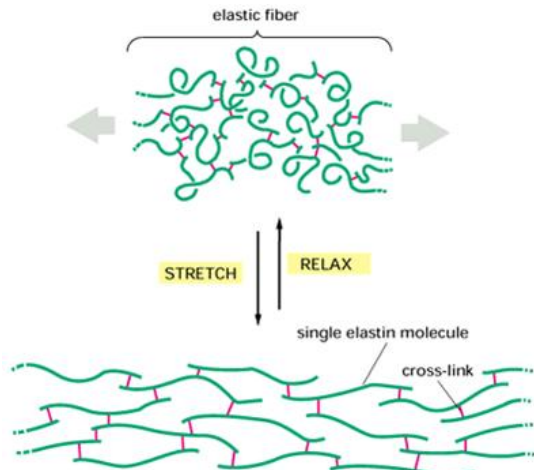
This project, named Human Tissue, had its introduction at a symposium under the same name. The organizers of this symposium work at different faculties at the TU Eindhoven. The University wants to have cooperation among these faculties. These faculties are the Biomedical Engineering department, Mathematics department, Technical Management department and the Building, Architecture and Planning department. So they came up with the idea for the project Human Tissue. The main subject had to be more knowledge about human skin and future possible using of this tissue. The student from different departments will work together and will learn from each other to come to a conclusion, supported by the broad knowledge of their departments.



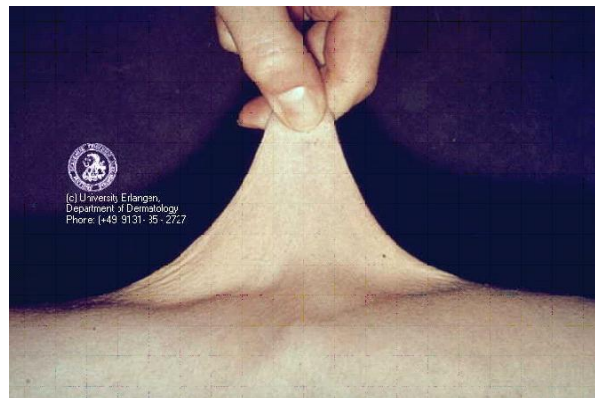
Pic. 1: Symbol of the symposium Human Tissue Inc.

Research proposal:

I want to investigate the structural advantages of human skin to come to a translation of a structural model for the use in construction. I will start this by doing a literature review. I want to get to know the structure of the dermis¹ and the epidermis². There seems to be some sort of scaffold in the epidermis composed by fibers and attachment points. The attachment points are very interesting and the scaffold accepts a lot of movement and rotations as you can see in your own skin. When the attachment points are missing, the skin is too elastic. This is a familiar disease called Diminished Collagen Cross-Linking.



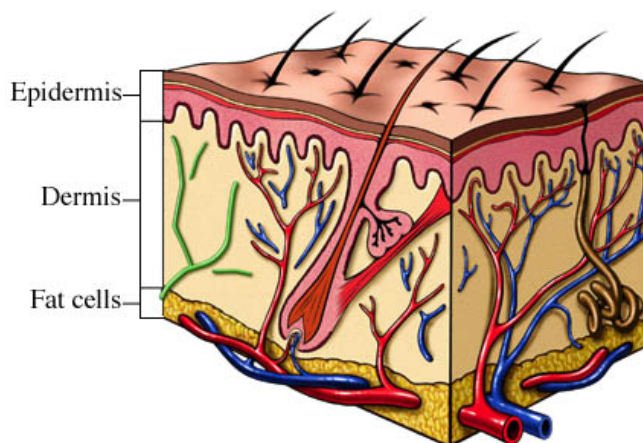
Pic. 2: The principal of structures in human skin.



Pic. 3: Symptom of Diminished Collagen Cross-Linking

The epidermis is built up by dead cells and has the function of protecting the body against external influences. The elasticity of this skin is less than the dermis. So how does this structure work?

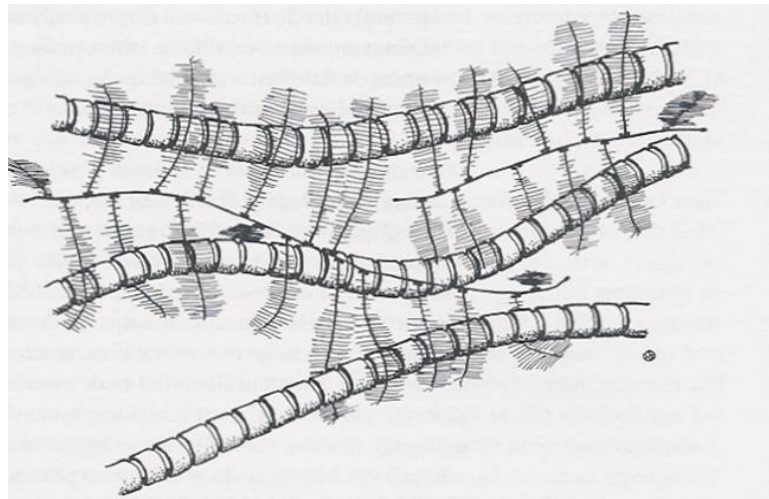
The elasticity of the skin is very interesting, because in different places of the human body, there are different elasticity properties. How does this work and why evolution took care of these differences in structure and elasticity?



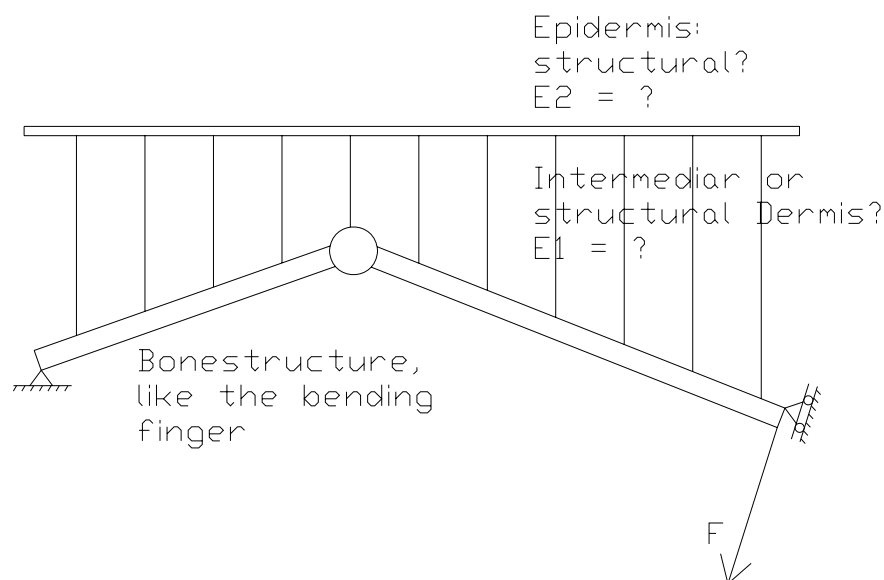
Pic. 4: The built of human skin

Because there is already been done some research in the matter of elasticity of the skin, I will first need to do literature study. I will search for the structure of the skin and the properties of the skin that came up by tests. This study can be done in cooperation with the BMT students. I won't look at the material behavior, because in a further phase I will translate only the structure of the human skin into a structure that can be used in construction. This structure must be able to deform when demanded and also have a static behaviour when demanded. It will cooperate with an internal beam structure inside the building and also take care for the closure of the building. Just like the human skin, muscle and bone cooperation.

Then I will also search for possible models and learn about structural modeling. First I will make a structural model of the skin in a two dimensional analyses. A scale model will be necessary to feel and analyze the resistance of the structure. In this phase I will translate the structure into line elements. Maybe when there is time left, I can make some steps to a 3 dimensional structure and work with volume elements. The structural analyses will be done by making use of the Finite Element Method of ANSYS.



Pic. 5: Principal of the scaffold in human skin.



Pic. 6: Possible translation of the mechanism of a finger.

Steps to follow for the research.

- Search for information of the structure of the skin by literature review.
- Search for specific intelligent properties of the human skin by literature review.
- Search for information about modeling in Finite Element Method by literature review and learn about modeling a line element structure.
- Translate the structure into a more simple and understandable model and usable in construction.
- Investigate the behavior of the translated structure by a scale model.
- Make a FEM model in a 2D line element ANSYS model.
- Explain the results in the computer and discover the structure boundaries.
- Try to give conclusions about 3D behavior of the skin.
- Try to give a 3D translation to construction.

Results

I hope to find a multiple functional structure in the skin which can be translated into a useful skin in construction. We will know more about the principle of structures in our skin and make use of that information. Maybe in the future we'll be able to make skins for a building that will have such elasticity that it can be form in any curve we like. A building can be designed in any form we like and change into any form we like.

1. Dermis = the skin layer which contains the structural fibers. This layer lies under the top layer of the skin, the epidermis.

2. Epidermis = the skin layer which contains fibers that don't work structurally, but are only used as a protection layer. These fibers continually renew themselves and are very thin.