

# **Sofa Bed Mechanism Simulation and optimisation**

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## **Abstract**

Target of this work is creating a 3D model of one of our products to test and develop it only in a virtual environment. We used MECHANISM, the I-DEAS CAD simulation task.

In present article will be explained first our targets and second the way to obtain it fast and better as much as possible.

We had analysed a twenty year old mechanism that is now in production and is one of the first mechanisms built for sofa-beds. It is constituted of several mechanical quadrilaterals that permit to close the sofa-bed in two phases: TWO MOVEMENT SOFA-BED.

We decided to analyse it to emphasise the efficiency and power of IDEAS-CAD tools in Styling manufacturing developing process.

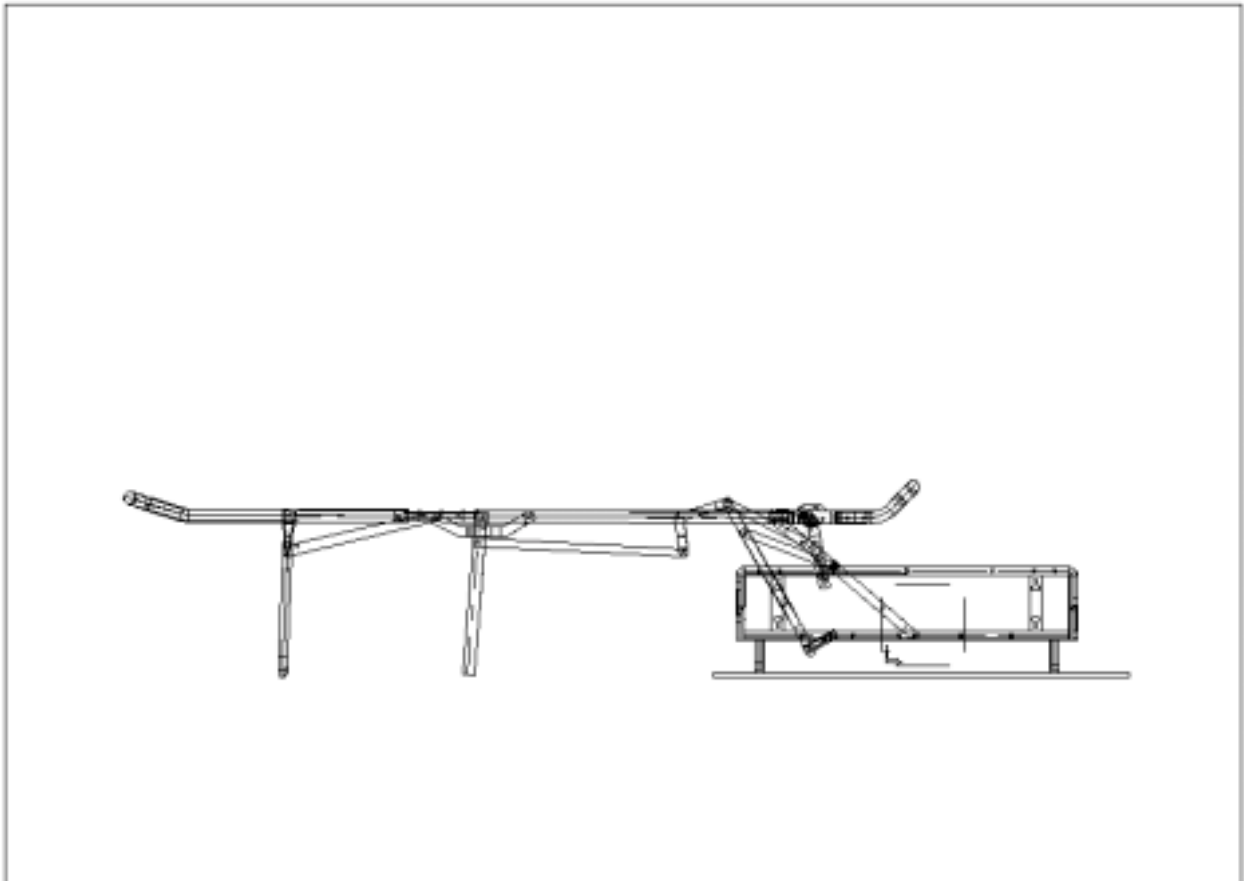
The model was designed, assembled and analysed in I-DEAS CAD environment. Cinematic analysis was done in 2D environment (Wire frame). Interference and dynamic analysis was done in 3D environment, using respectively MASTER ASSEMBLY and MECHANISM DESIGN where the BUSHING constraint was fundamental to simulate the deformation behaviour of some critical quadrilaterals points.

## Introduction

Styling Industrial Group is a world leader in sofa-beds production with experience of about thirty years. It produces more than twenty cinematically different models.

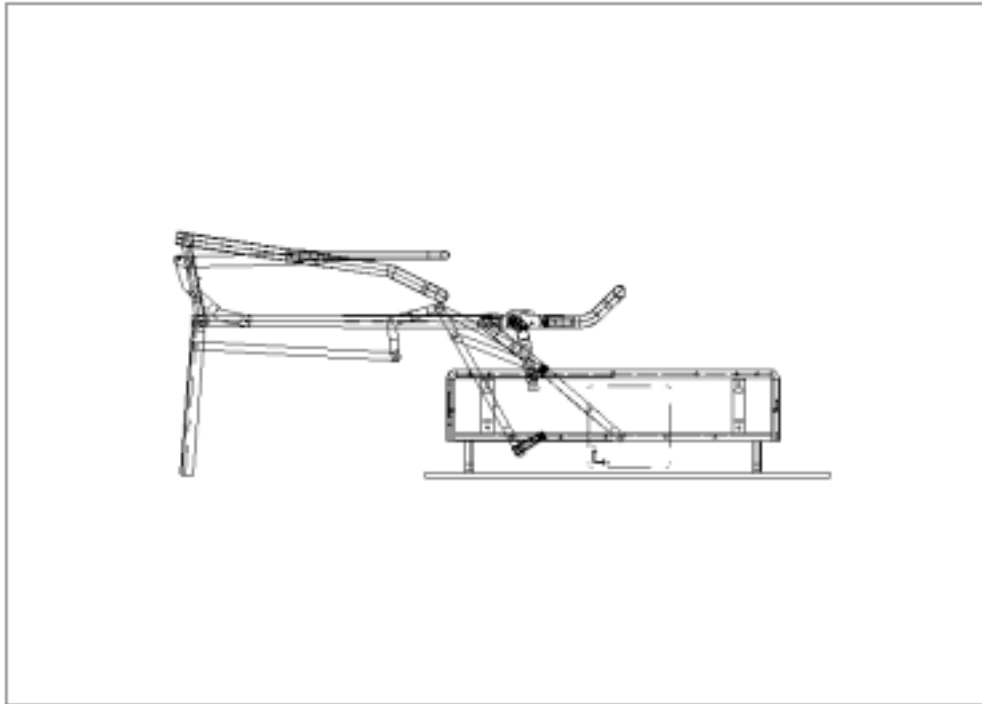
Styling makes 90% of the mechanical component of his products. Styling engineering staff works full-time to find and develop, together with prototyping department, new models and new solutions to improve the products performance.

## Two Movements Sofa-Bed

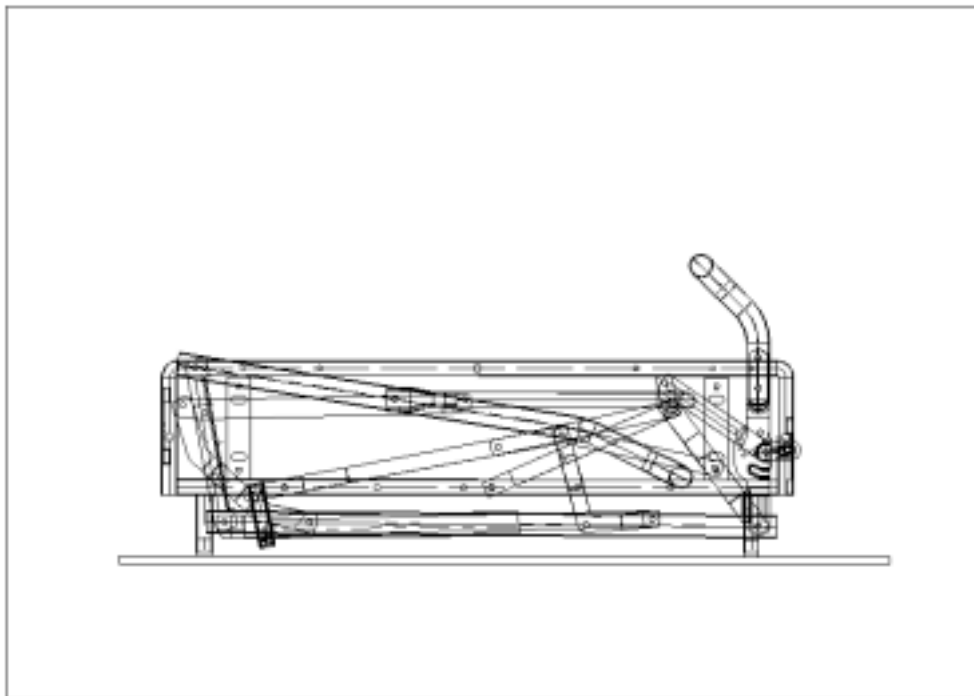


*Fig.1*

Two Movements Sofa-Bed has tow degrees of freedom, it go on from open to close configuration in tow different steps.



*Fig.2*



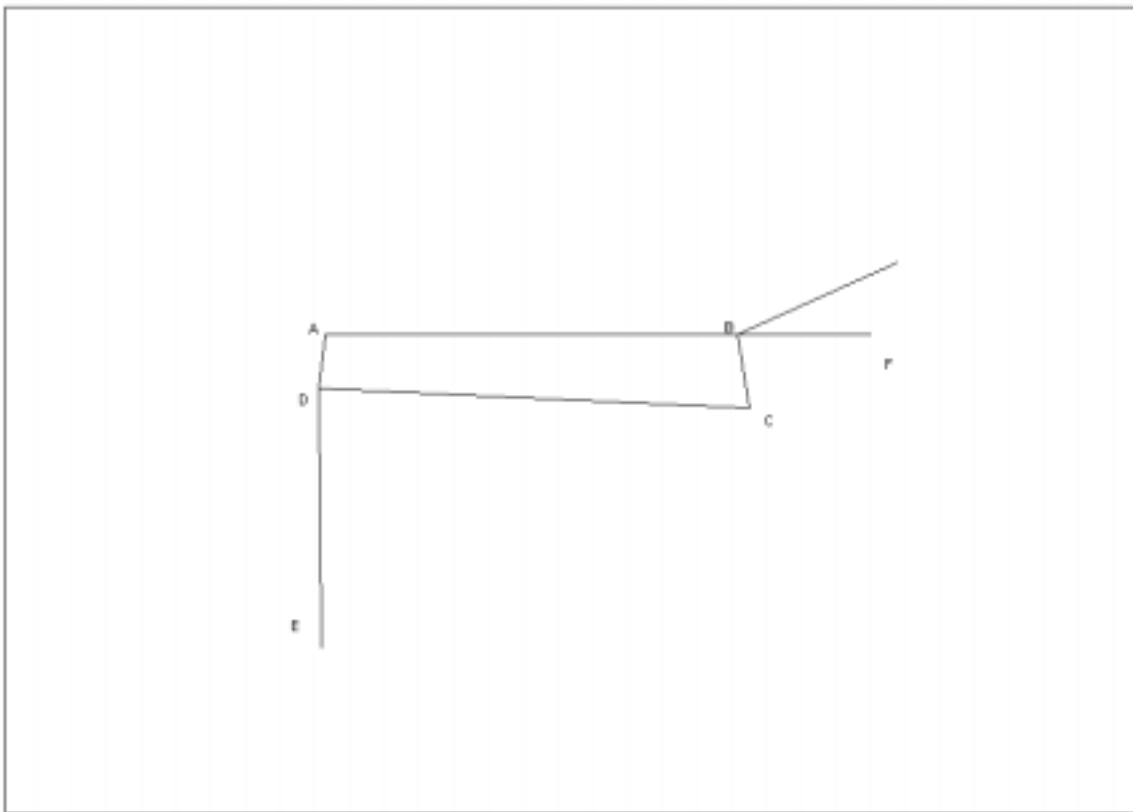
*Fig.3*

We decided to analyse one of the most ancient Styling models to emphasise the efficacy of IDEAS-CAD tools to better the Styling manufacturing developing process; in fact using this tools we were able to improve mechanisms traditionally untouchable, because widely experimented.

Two Movements Sofa-Bed is composed of tow distinct modulus cinematically independent, everyone whit one degree of freedom, Fig.1.

The first module is composed of tow articulated quadrilaterals; his working is go on bed in “U” configuration and maintain it in close position against mattress reaction forces, Fig.2 (first step of closing procedure).

Second module is composed of four articulated quadrilaterals, joined to obtained one freedom degree in the second step of closing procedure. The movement of this module is very critical for us, in particular we are interested in ABCD quadrilateral configuration, Fig.4 and equation [1]; his working is to move and maintain the AE foot coaxial with the central bed tube (AF) when the sofa-bed is in definitively close configuration (second step of closing procedure).



*Fig.4*

$$\overline{AB} + \overline{BC} > \overline{AD} + \overline{DC}$$

[1]

AE foot will be in right position when C point of CBG lever going up to AF tube; in other way it must overtake his break point and satisfy equation [2]. For equation [1] this is impossible, but lever are elastic bodies and can satisfy the equation [2] if correctly dimensioned.

$$\overline{AB} + \overline{BC} = \overline{AD} + \overline{DC} \quad [2]$$

MECHANISM DESIGN has been very important for us in this elaboration; in particular BUSHING constrain in A and B position that permitted us to obtain a right dimension of ABCD quadrilateral.

Our principle target in dynamic analysis is evaluate the forces to develop mechanisms whit:

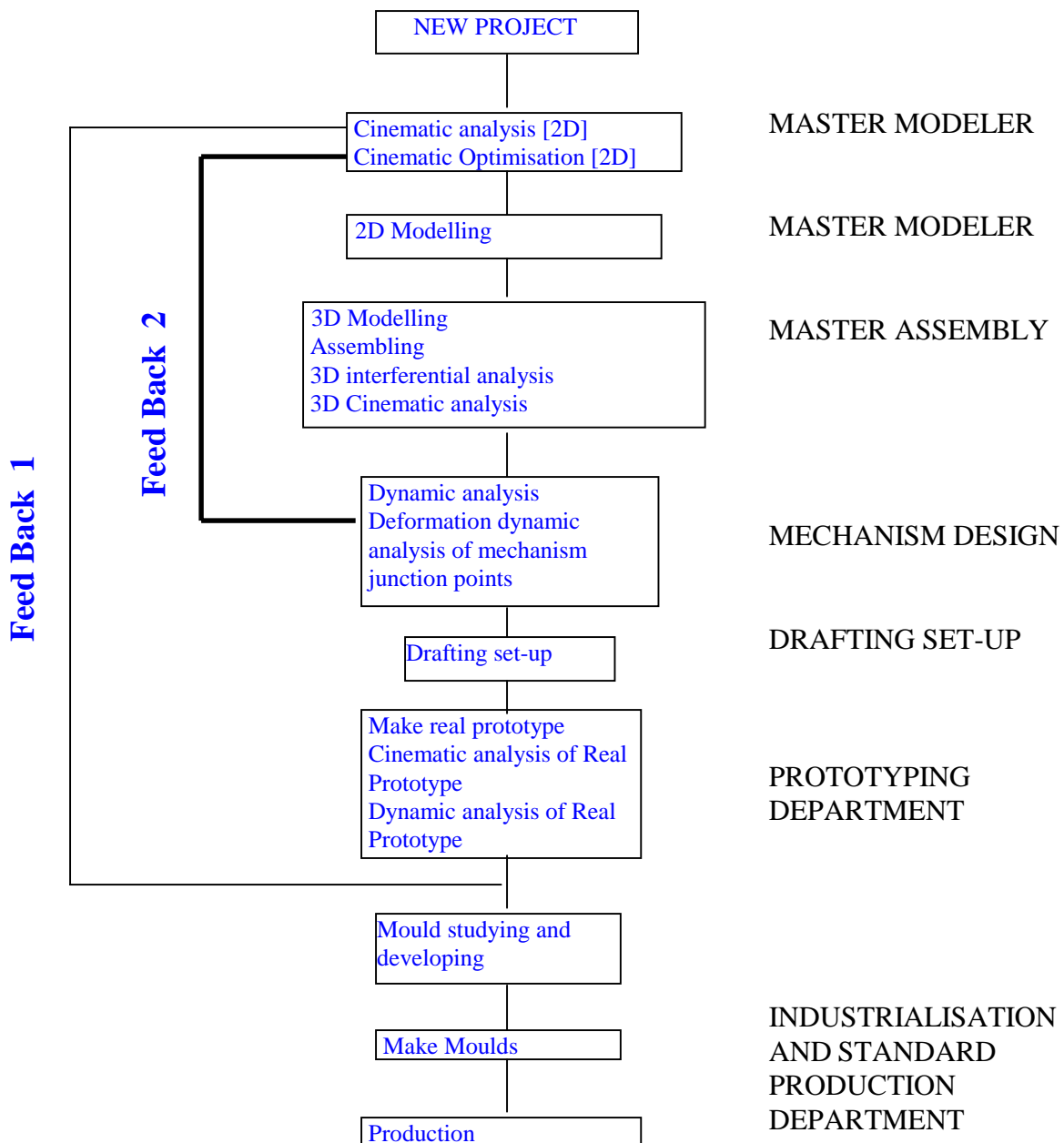
- right trajectories and cinematically configurations;
- not permanent deformation (breaking);
- easy handy using.

# Projecting and developing whit MASTER MODELER, MASTER ASSEMBLY and MECHANISM DESIGN

A large part of Styling mechanism components are cold pressing made, therefore time of industrialisation phase include mould developing and studying phase. Considering that is long and expensive modify a mould, is very critically the components projecting and prototyping phase to reduces time industrialisation phase (more exactly is the draw of components better and fast is mould developing and studying phase) and consequently time delivery product for standard production.

The goal in bettering our projecting and prototyping phase is a large uses of virtual prototyping procedure that shorter twain: more long and expensive real prototyping phase and mould developing phase. For this purpose we use IDEAS-CAD tools.

Will follower a flowchart of our prototyping and industrialization procedure:



During a prototyping procedure FEED BACK 1 was very frequently before using IDEAS-tools. Now, in particular using MECHANISM, FEED BACK 2 is very frequently. In this way we obtained following results in our prototyping and industrialization procedure:

- Bettering time and costs of projecting phases;
- More durability in Styling products;
- Fast marketing Adaptability.