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Large Scale Stamping Assembly - LaSSA

Large assemblies in shell design (cold-formed) as an alternative to MegaCasting

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Outline

Overview

1 **Motivation and objective**

2 **Work packages**

3 **Timing and organization**

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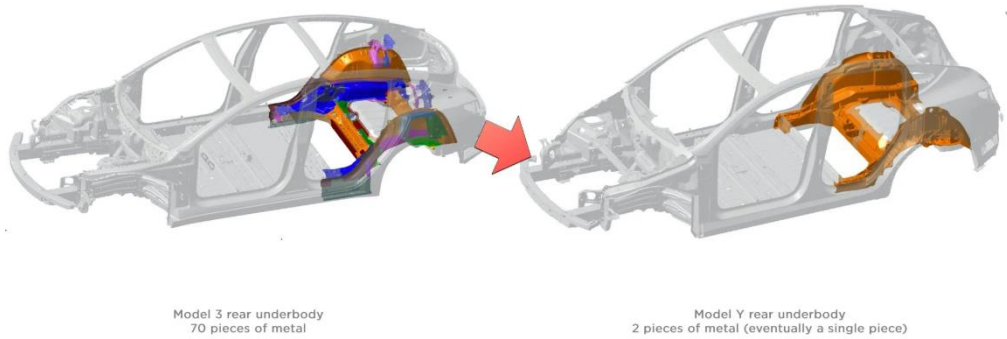
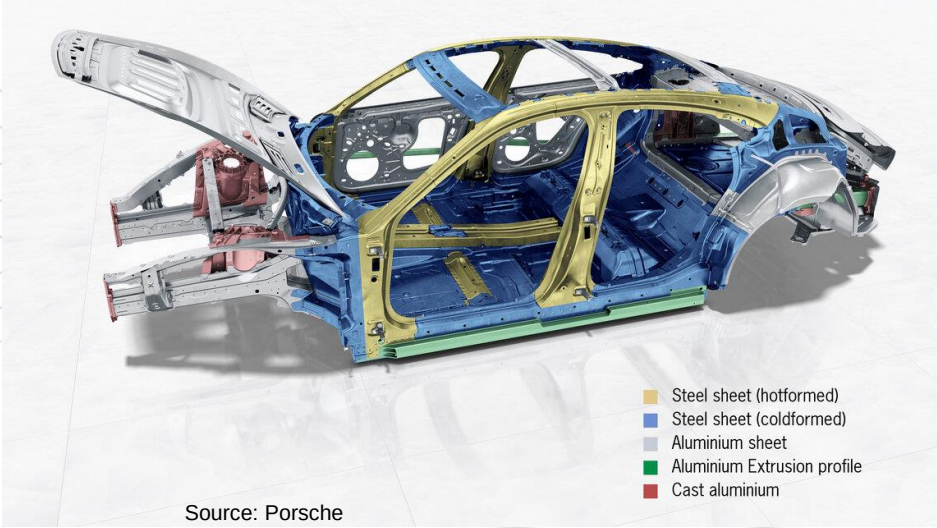
Motivation

Large cast aluminum

- Current body concepts include the use of large-scale aluminum castings as an alternative to conventional sheet metal construction.
- One advantage can be the reduction of assembly stations, which can result in
  - Shortened assembly time
  - Reduction of the equipment footprint
  - Reduction of equipment (robots) in assembly
- Technological challenges including:
  - Quality of large castings (porosity and cracking)
  - Tool life
  - Repair concepts



Source: https://electrek.co/2021/11/30/tesla-giga-casting-strategy-adopted-dozen-automakers/



Source: Porsche

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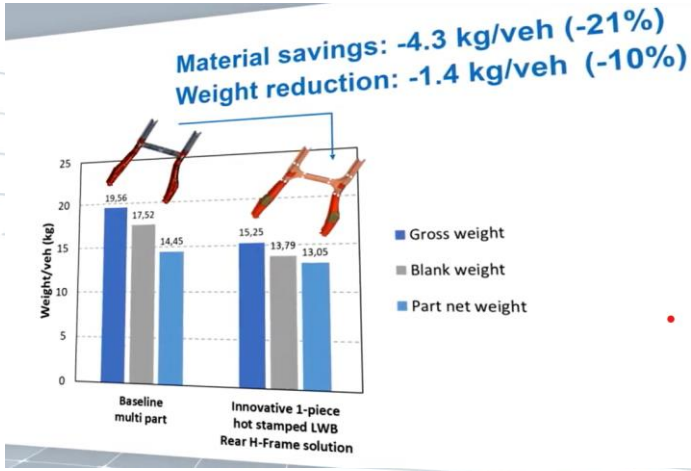
Motivation

Large scale formed parts: Hot forming

- Approaches for large PHS assemblies already exist and are marketed accordingly
- Hot-formed large components are possible due to the lower process forces required
- The springback behavior of hot-formed large components permits compliance with narrow tolerance fields
- Components have no or reduced mechanical notches, there is no need for sheet doubling, load guidance is improved due to homogeneous transitions
- Challenges:
  - KnowHow of thermo processes (partial) heating, (partial) cooling.
  - Patented processes and semi-finished products
  - For "tailored" semi-finished products, ensuring tool contact at relevant points (thickness tolerances, ramps at TRB, thickening of weld seams...)

Source: Gestamp



Source: ArcelorMittal

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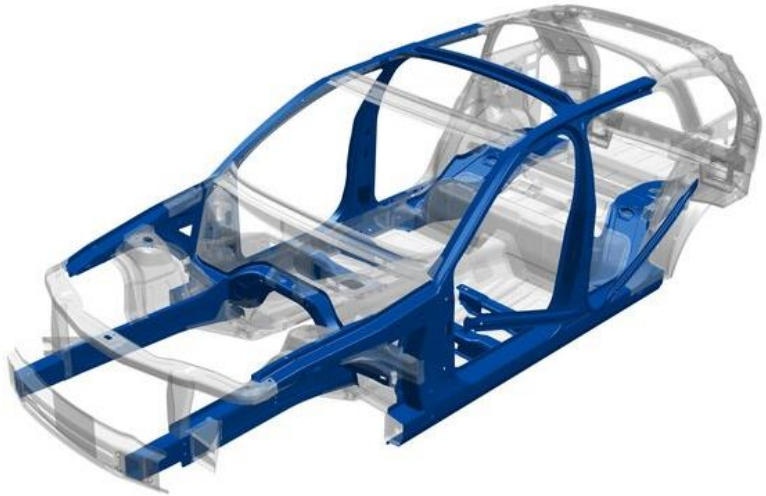
Motivation

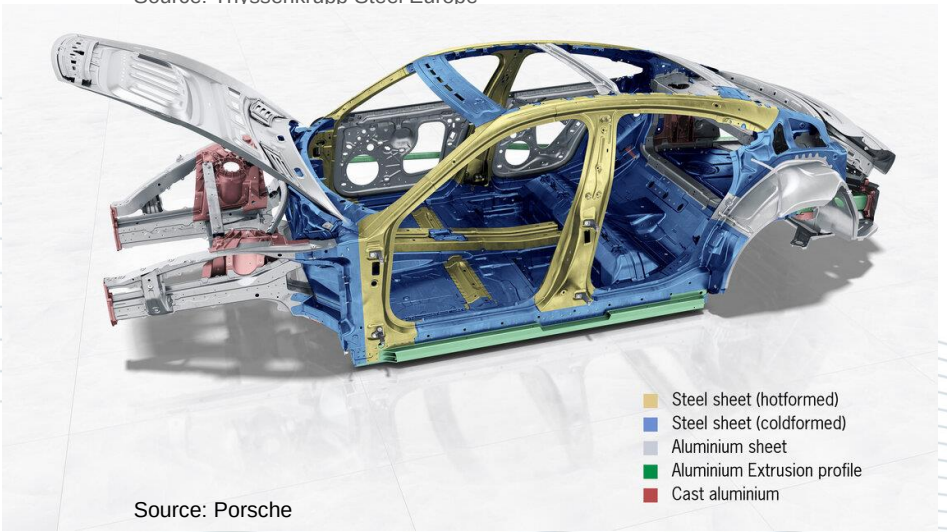
Large scale formed parts: Cold forming

- Among other things, current body concepts are pursuing the approach of large-scale aluminum castings as an alternative to the classic body construction method of joined sheet metal components.
  → What is the potential for cold-formed, large-scale components?
- Opportunities:
  - Savings in joining operations, load path optimization, reduction of required equipment in the Assembly.

- Which materials, joining processes, forming processes and process routes have the greatest potential compared with large cast components?
- When evaluating different material and manufacturing concepts, a variety of criteria must be considered (including manufacturing costs, CO2 balancing, tolerance management and resilience)
- For which process-related constraints are there solutions to?



Source: Thyssenkrupp Steel Europe



Source: Porsche

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Objective and benefit

Aim of the project:
Procedure for the design and evaluation of large-scale, cold-formed assemblies based on a reference assembly.

Benefit and result

- Overview of possible solutions in the current competitive environment
- Method for the development and evaluation of large assemblies
- Evaluation of different process routes and variants
- Evaluation of influences/interactions between manufacturing variants and mechanical performance of the assembly
- New, innovative solution possibilities beyond the already known solutions
- Regular discussions and exchange in the expert group
- Joint design of selected project content

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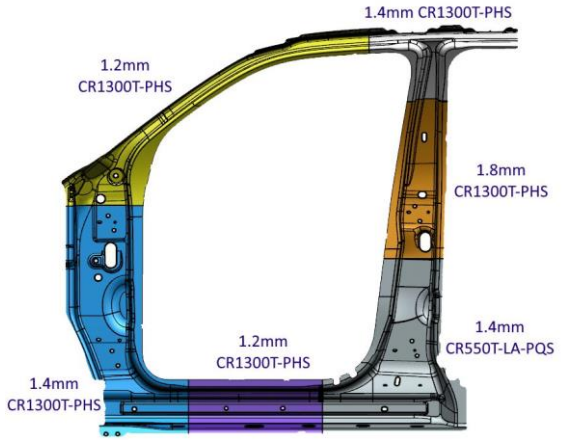
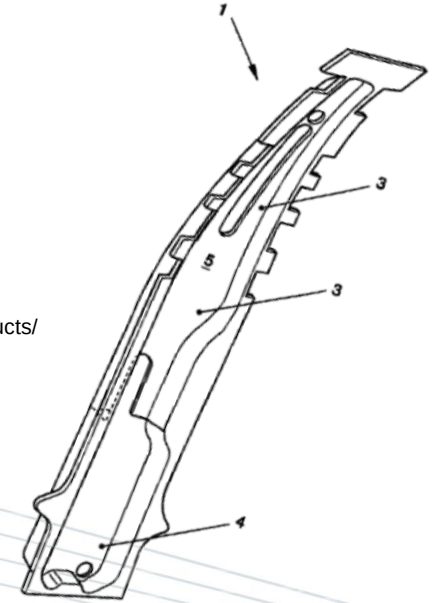
Work plan

WP1: Research patents and market solutions

- Research of relevant existing patents in the field of sheet metal assemblies (cold formed)
- Market research of existing assembly solutions
  - Manufacturing technology
  - Assembly structure
  - Materials
- Identification of a current reference body assembly (documents RMB, Bad Nauheim, ...) incl. identification of a typical, representative specification sheet
- Identification of the individual sheets used (typical wall thicknesses, material grades, manufacturing processes) and joining processes (WPS, inert gas, ...)



Doorring as press hardening assembly
Source: https://ahssinsights.org/forming/tailored-products/tailored-products/



Source: E P 0 9 5 3 4 9 5 A 2

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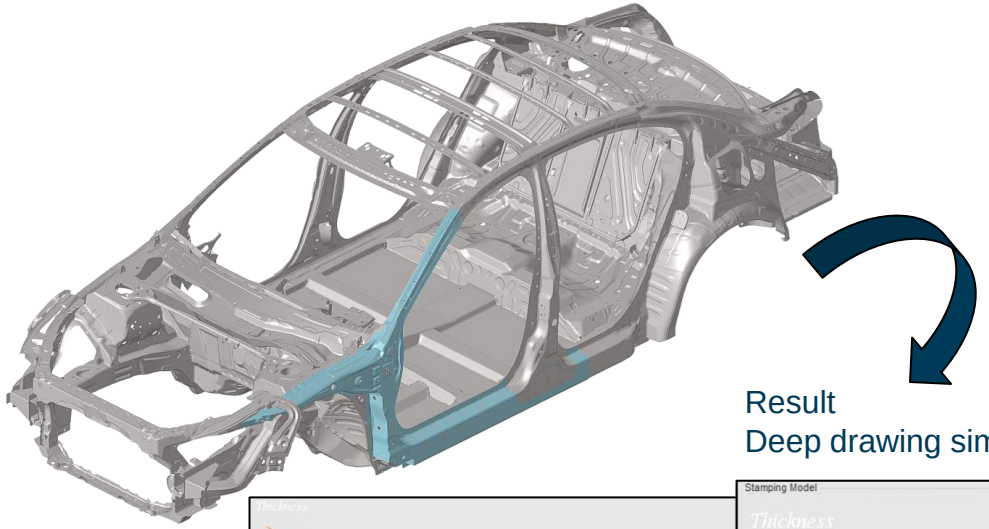
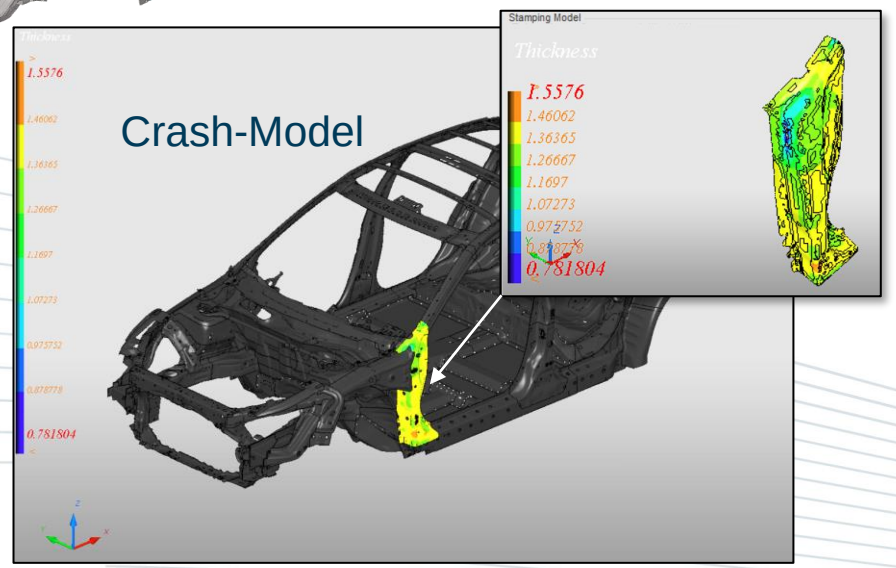
Work plan

WP2: Analysis reference system

- Design of virtual assembly (acs vehicle model)
- Analysis of load distribution
  - Determination of critical points (stress)
  - Determination of system stiffness
- Evaluation of the reference assembly with regard to costs
  - CO2 balance
  - Crash + static performance; lifetime is not considered
  - Tolerance management
  - Process chain/manufacturing method
  - Further criteria to be defined as required
- Derivation/revision of specifications as reference



Result
Deep drawing simulation



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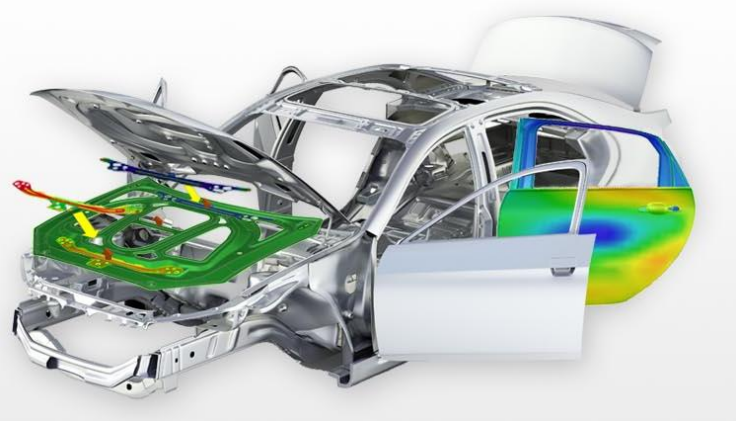
Work plan

WP3: Development of rough concepts of the assembly

- Definition of variable parameters and variation space
  - Material, sheet thickness, position of joints, joining method, ...
- Consideration of different production routes (classic Assembly, patch from coil, preforms, ...)
- Development of a test plan (virtual) for concept variants
- Comparative evaluation of the rough concepts with reference system



https://www.autoform.com/fileadmin/public/Redaktion/all/products/AutoForm-Explorer_Assembly.jpg

https://www.european-business.com/portraits/arcelormittal-tailored-blanks-nv/meeting-the-automotive-challenge

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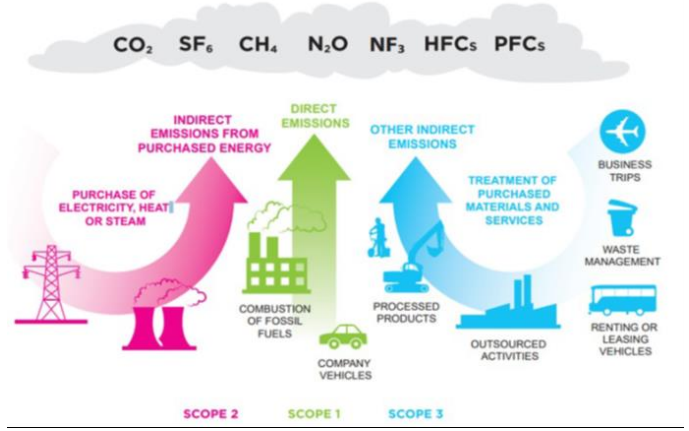
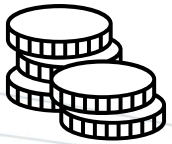
Work plan

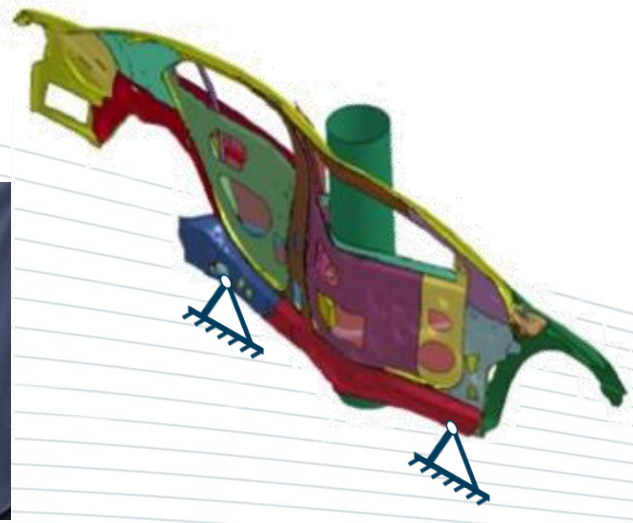
WP4: Detailing of selected rough concepts

- Detailed consideration of max. three rough concepts
- Evaluation of the variants with regard to
  - Costs
  - CO2 balance
  - Crash performance
  - Tolerance management
  - Manufacturing processes and individual constraints (joining, coating ...)
- Derivation of criteria for the evaluation of different manufacturing concepts



Source: Wikipdia





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Work plan

WP5: Documentation

- Development of an overview (decision) matrix
  - Material usage
  - Efforts Shaping & Joining
  - Crash & stiffness performance
- Documentation of results

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Work plan

Organization

- Project start: Q2/2023
- Project duration: 24 months
- Project costs: 16,000 EUR/year

Notes:

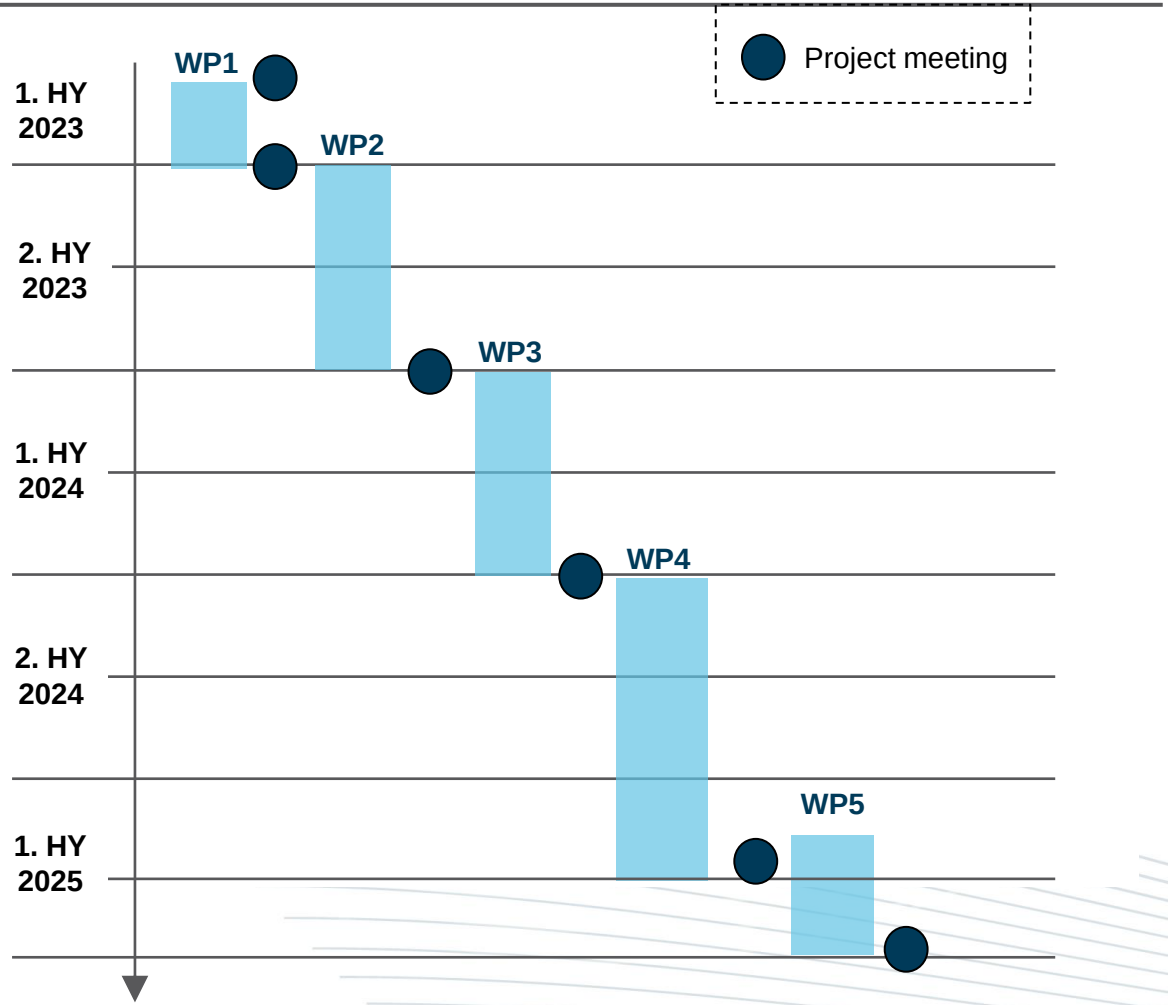
Within the scope of the project, the general terms and conditions of Automotive Center Südwestfalen GmbH apply, as well as additional project agreements, if applicable.

The project costs are to be paid annually in advance; travel expenses are not included.

Company-specific project extensions and individual analyses are possible.

A minimum number of participants is required for the project

Participation is also possible after the start of the project by paying the full project costs.



Thank you very much.

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