

Meeting on safety of tractors and agricultural machinery

INAIL-Regione Emilia Romagna

Research on the adjustment of agricultural tractors from Roll Over Risk

*Leonardo Vita
Davide Gattamelata*

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Expo MILANO

Roll Over accident and Safety Devices in 2006



The operator was travelling with his agricultural tractor connected to a trailer. Due to a sudden depression of the ground the tractor rolled over and the operator remained crushed beneath it.

The tractor was not equipped with a ROPS and a restraint system.



While working with tractor in the field he lost the control sliding on the grass and rolling over three times.

The tractor was not equipped with safety belt.



Background

Fatal Accident 130 fatalities/ year



2006

1,5 million of old tractors which need to be fitted with ROPS and seat belt



Design, prototyping and experimental testing of ROPS to be fitted on old tractors

INAIL National guide line



2008



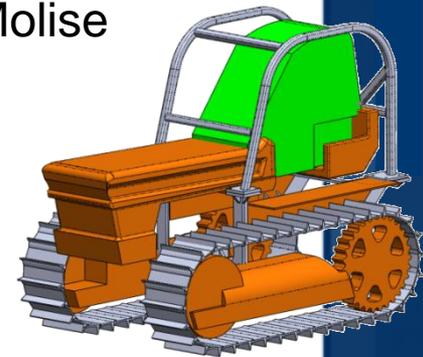
Retrofit ROPS Data Sheets [42 tractor models].



2011



Molise



2014

Convenzione



ISPEL – Regione Emilia Romagna – Università di Bologna
24 giugno 2008

CONVENZIONE

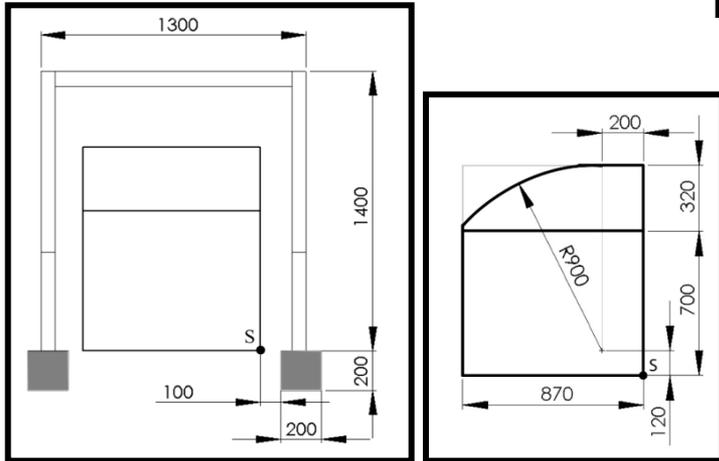
PER LA REALIZZAZIONE DI UN'ANALISI FINALIZZATA ALLA INDIVIDUAZIONE DI SOLUZIONI TECNICO-COSTRUTTIVE PER L'APPLICAZIONE DI DISPOSITIVI DI PROTEZIONE DEL CONDUCENTE IN CASO DI RIBALTAMENTO IN FUNZIONE DELL'ADEGUAMENTO DEI TRATTORI AGRICOLI E FORESTALI AI REQUISITI MINIMI DI SICUREZZA

a) attività ISPEL:

- a.1 progettazione di 37 telai di protezione dell'operatore a bordo in caso di capovolgimento, relativi ad altrettanti modelli di trattore;
- a.2 reperimento di n. 25 trattori agricoli e realizzazione ed installazione dei corrispondenti telai progettati;
- a.3 effettuazione, secondo le metodologie stabilite dalle specifiche Direttive Comunitarie, dei test sui 25 telai nel centro prove di Monte Porzio Catone (RM);
- a.4 assistenza tecnica e la supervisione generale di tutte le attività oggetto della presente convenzione, ivi comprese quelle di cui alla successiva lettera b);

INAIL National Guideline contents

The INAIL National guideline is made up of:



- **General section** which contains the common requirements for all the typologies of ROPS and tractors;
- **Annex I** made up of 77 technical data sheets containing information for realizing the frame-type element of ROPS;
- **Annex II** which contains the technical requirements for realizing the ROPS mountings;
- **Annexes III, IV, V** which contain procedural form for the realization and installation of ROPS;
- **Technical addendum** made up of 42 technical data sheets containing information for realizing ROPS for the most widespread models of tractors in Italy.

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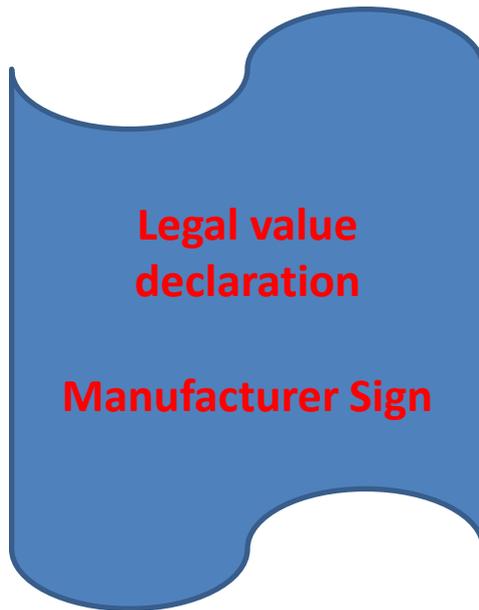
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Tested Structures

Retrofit examples



Retrofit examples



LG - Retrofit examples



LA LINEA GUIDA ISPESL

Esempi di adeguamento



Fiat 120 C



Roll Over Risk Reduction

Unsafe condition: roll-over protective structure (ROPS) is not installed, or, in the case of two post front mounted foldable ROPS, it is disabled by the operator in order to carry out some particular duties (e.g. in vineyards).



Fatal Accidents



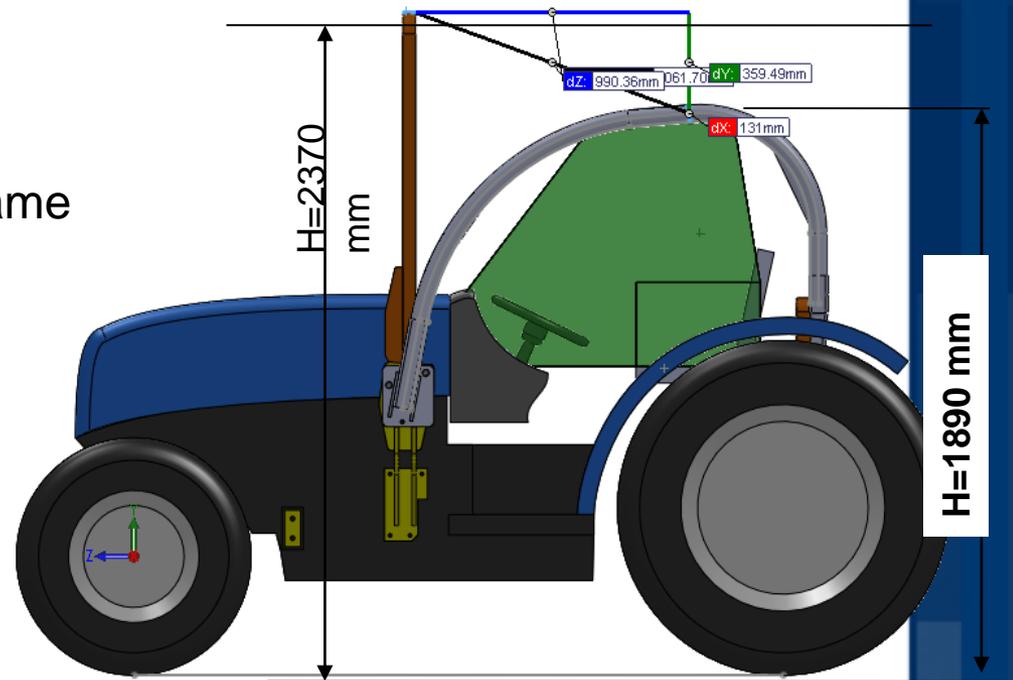
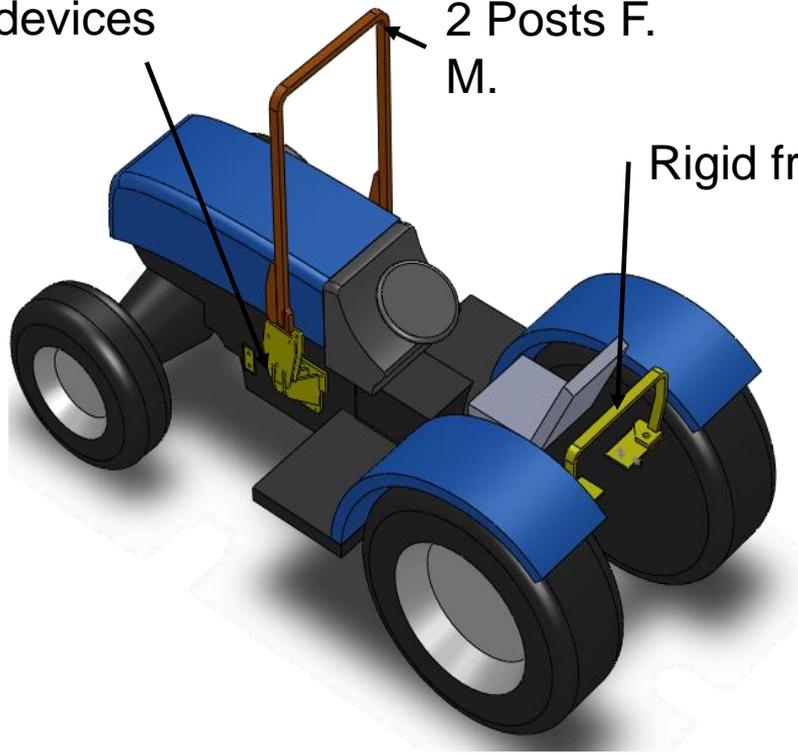
CROPS (Compact ROPS)

2010 The first prototype of CROPS.

Anchorage front devices

2 Posts F. M.

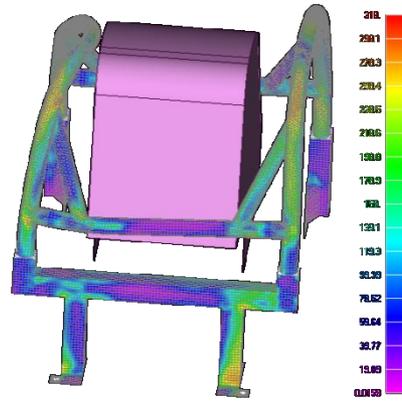
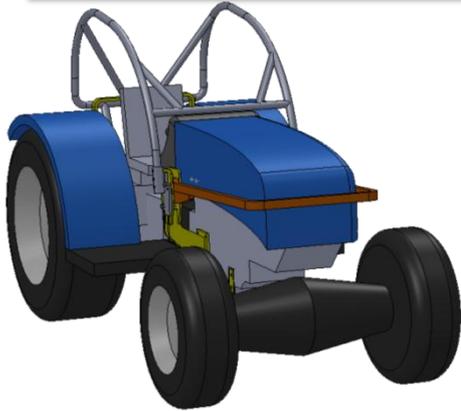
Rigid frame



Risk reduction by using a compact profile

CROPS: design features

Design and proof by mean of virtual engineering tools.



F.e.m. non linear Analysis



Testing in agricultural fields (vineyard , orchard,..)

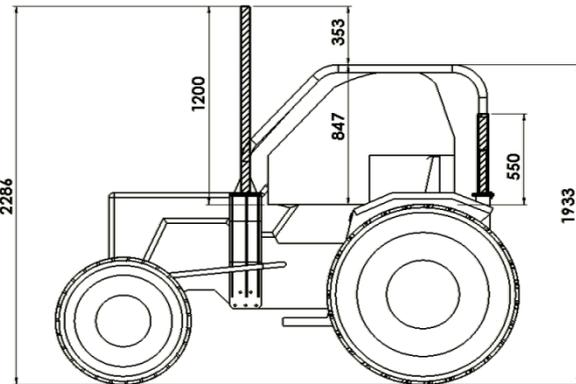


Retrofit purposes

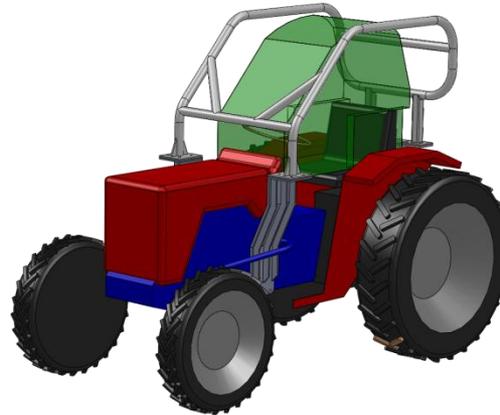
Retrofitting with CROPS

Retrofit ROPS process for SAME Delfino in steel S235 J

Design phase



Virtual Prototype

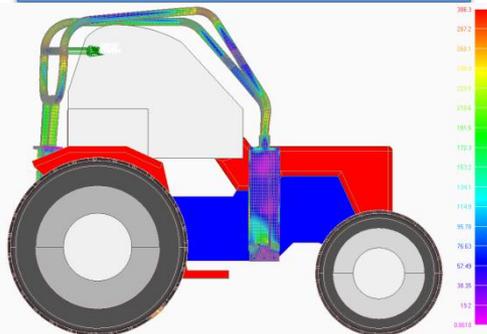


Physical prototype

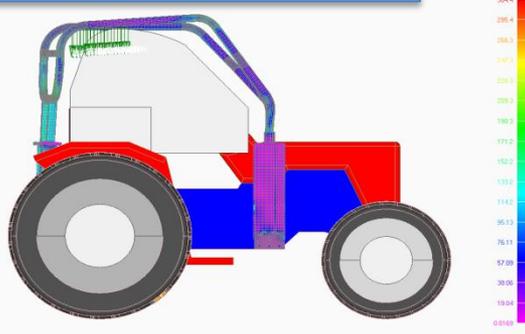


F.e.m. simulation in compliance with OECD CODE 4

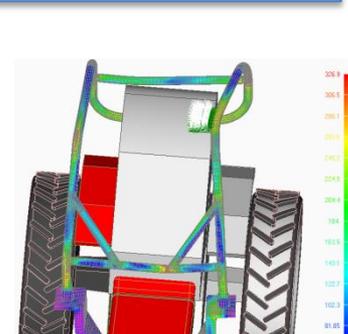
1. Longitudinal Loading



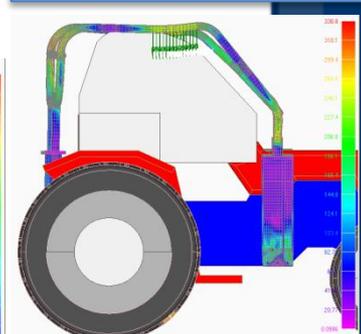
2. Crushing at the rear



3. Transverse Loading



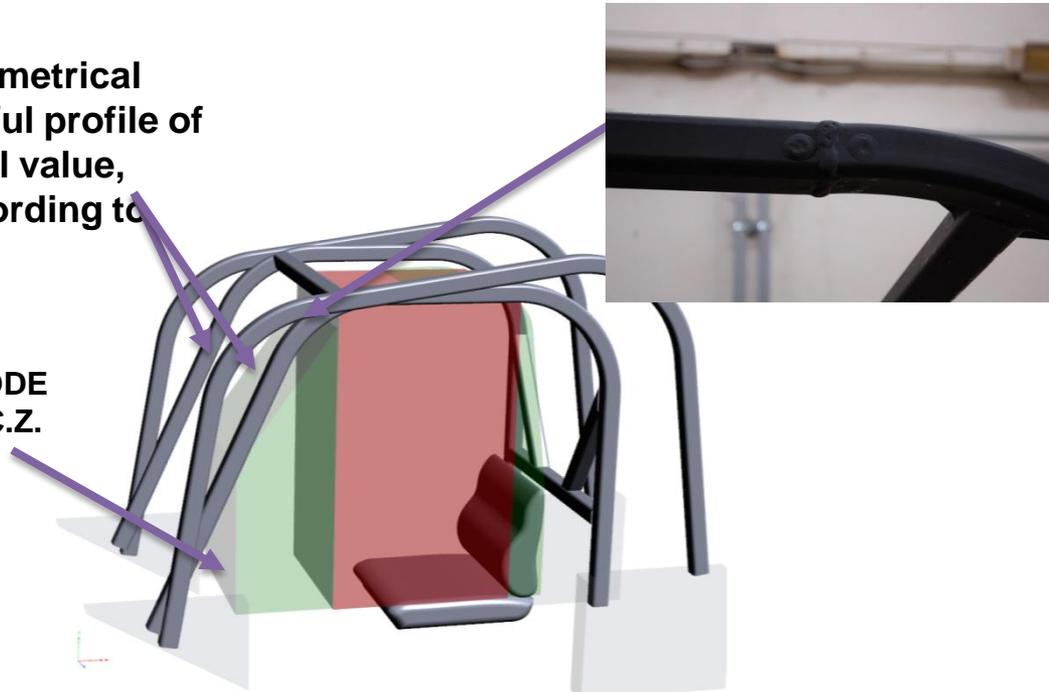
4. Crushing at the front



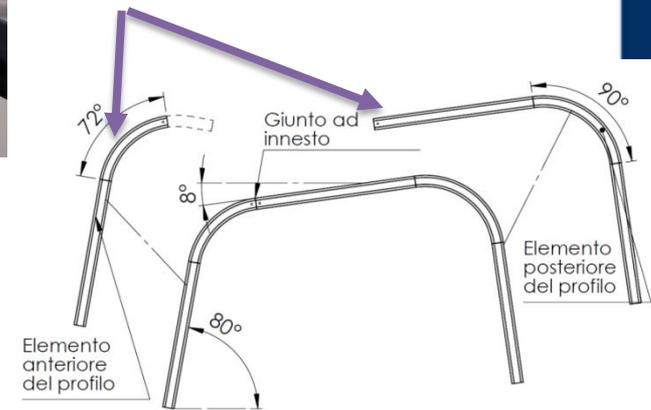
Retrofit Compact Ropes in National Guidelines

Geometrical useful profile of legal value, according to

CODE 4 C.Z.

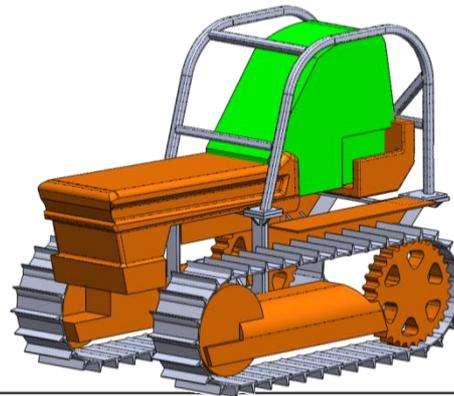


Nested steel joint

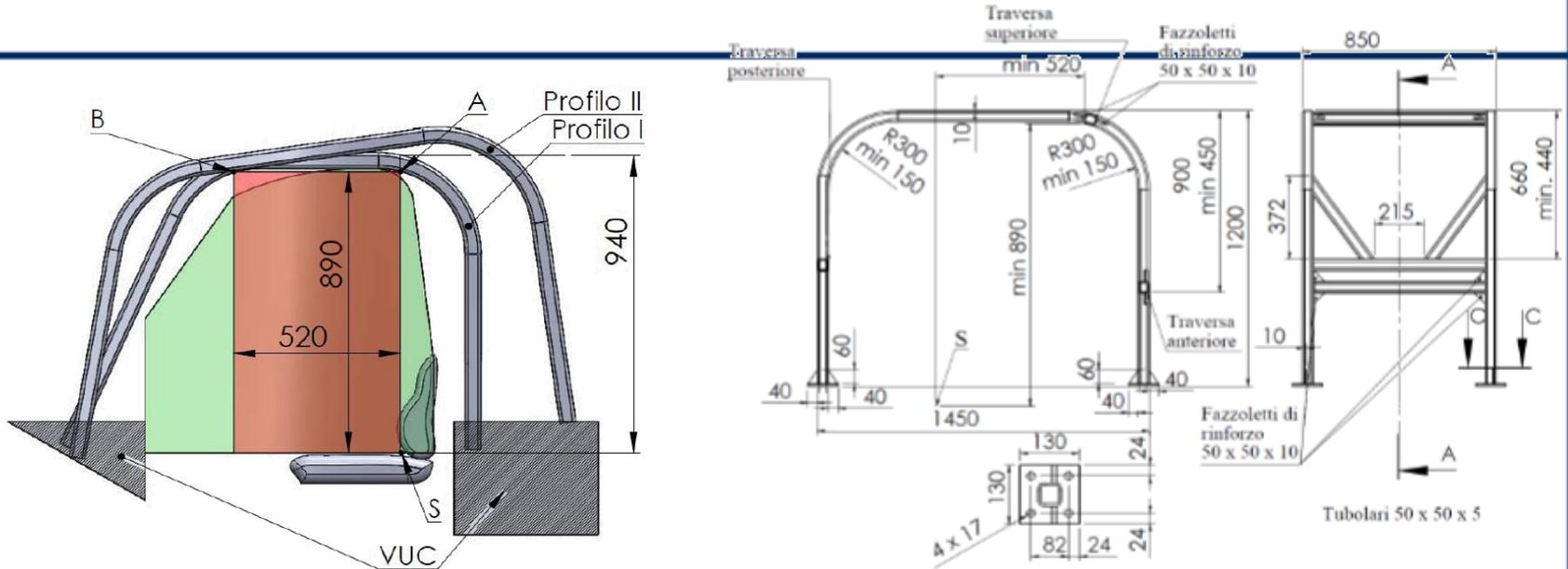


Results

April 2014 Specific retrofit cards with technical information to build and to install compact ROPS on the old tractors.

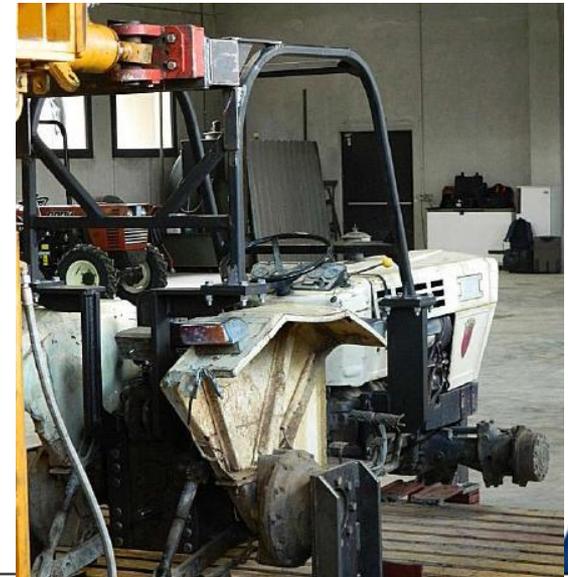


CROPS in National Guideline



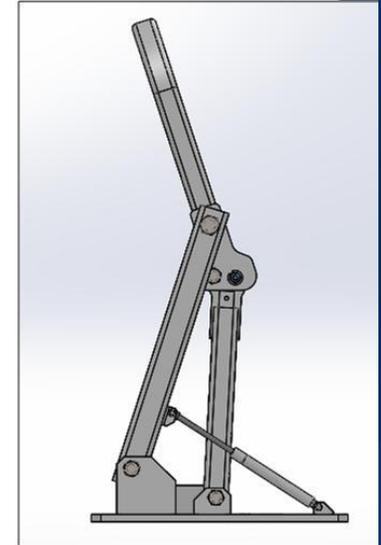
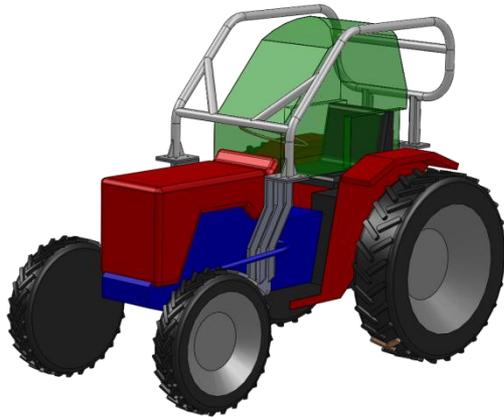
Three Models in ADDENDUM

SEZIONE C-C
SCALA 1 : 10



Automatic total foldable ROPS

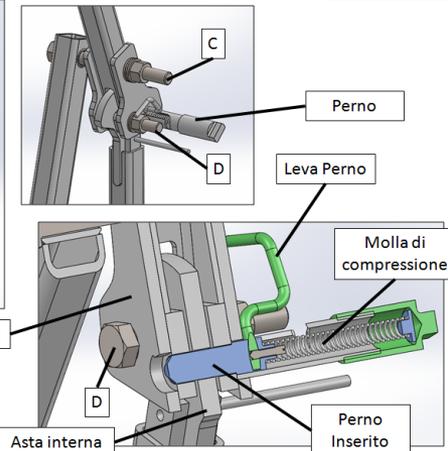
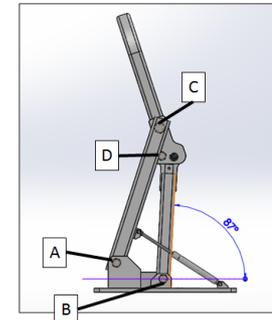
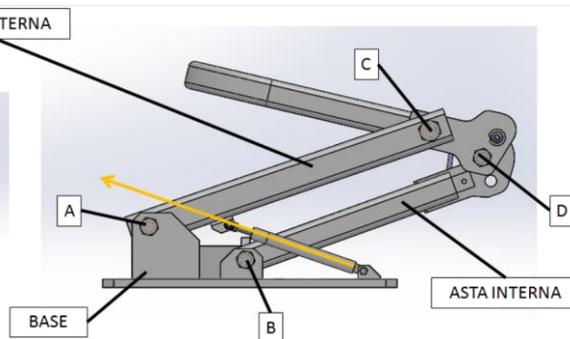
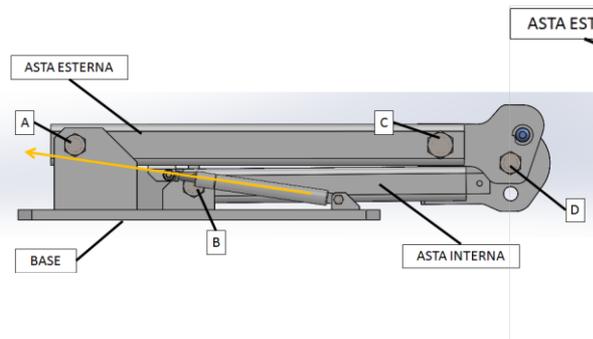
Give to the user another optional retrofit structure



Completely folded

Activated

Locked in safe position



Springs and actuators let the activation of the ROPS in 0,5 sec

ARCO APERTO:
-angolo di apertura 86.8°
-perno inserito

Roll Over Risk reduction: the future

Design of Compact Tractor with reduced overall height.

The goal is to design and construct the compact tractor prototype in next year.

