## **GRM CONSULTING**







# **GRM CONSULTING**

Application for Consideration of GRM Consulting as a Supplier of ROPS Simulation Services for National Approvals by Motorsport UK



## Introduction

- The information contained within this PowerPoint has been requested by John Ryan of Motorsport UK.
- GRM has included the details required, plus other relevant information to demonstrate the depth of GRM's experience.
- For any queries regarding this information, please contact:
  - Oliver Tomlin Engineering Director, GRM Consulting
  - oliver.tomlin@grm-consulting.co.uk
  - 07535 518908
  - 01926 889300



#### **Contents**

- Company Background
- Team Background
- Individual Background
- Professional Indemnity Insurance
- Proof of Capability



## **Company Background**

- GRM Consulting was established in 2003 to provide structural simulation services and advanced optimisation software to the Automotive and Motorsport industries.
- Since then it has expanded to support organisations in the Aerospace, Defence, Medical, Rail, Marine and other sectors.
- The organisation is privately owned and independent, with a consistent steady growth yearon-year.
- GRM owns all its own software and hardware, operating a continuous development programme to give the organisation resilience and self-reliance.
- GRM follows many automotive industry standard simulation practices, as well as leading them through methods development and research studies.







www.grm-consulting.co.uk



#### ROSC SIMULATION Team Background

- The GRM consulting team consists of 10 engineers, supervised and guided by 2 directors. All GRM engineers are degree qualified and trained to use the latest simulation methods.
- We engage with the IMechE to develop our engineers towards Chartered status and two of our team are currently Chartered.
- We operate a defined training and development plan throughout the first 5 years of an employee's tenure at GRM, before they begin specialisation in a chosen discipline.
- The methods utilised by GRM to assess ROPS match those used by other organisations in this field, specifically the non-linear, dynamic FE Code LS-Dyna.
- Our services in ROPS simulation are shared via our website at:
  - http://www.grm-consulting.co.uk/our-services/grm-rosc





#### ROSCIL OVER SIMULATION CENTRE TEAM TEAM Background

- The GRM Roll Over Simulation Centre has over a decade of experience in the design, development and analysis of ROPS. First working with Safety Devices in 2003 to develop and calibrate simulation methodologies, the team has developed an unrivalled understanding of ROPS.
- Projects to date have covered all elements of ROPS simulation in the Automotive, Military, Off-highway and Motorsport industries. Relevant ROPS project highlights delivered by the GRM team have been:
  - Military Jeep BPV/LPV and Fox
  - Automotive European and Indian OEM vehicles to FMVSS 216a
  - Motorsport Development of various Hoops and Full Cages for Single Seaters and Sports Prototypes assessed to the relevant FIA standards, in advance of submission to an MUK/FIA approved organisation
  - Off-highway ROPS and FOPS for a tractor programme to SAE J231
- GRM's Roll Over Simulation Centre therefore represents a centre of excellence in gradient analysis of ROPS for various applications.
  www.grm-consulting.co.uk

- The Roll Over Simulation Centre is led by Oliver Tomlin
- During Oliver's previous employment at MIRA (1998 to 2011) he carried out all the work which led to MIRA gaining approval for ROPS simulation by the FIA.

ROSC ROLL OVER INDIATION Individual Background

- During early 2004, Oliver carried out all the simulation work and correlation to test which gained the FIA approval. His work covered the methods required to accurately and confidently predict a ROPS test result.
- Following the approval, he conducted over 100 ROPS simulations and signed all the ROPS certificates as a Chartered Engineer. Oliver worked closely with most UK ROPS manufacturers and consulted with the MSA on ROPS design and approval methods.
- Oliver is a Chartered Engineer and GRM's Engineering Director.

Engineering Director





## **Professional Indemnity Insurance**



 GRM retains Professional Indemnity Insurance to a total limit of £1m.



## **PROOF OF CAPABILITY**



## **Proof of Capability**

- The following slides are taken from a report supplied to Motorsport UK (then MSA) in October 2015.
- They were created to prove GRM's simulation capabilities, with the simulation results being supplied to Joe Hickerton in advance of the test.
- GRM met all the requirements and demonstrated a very good prediction of the test.
- Unfortunately the test load was applied in 30 seconds, 15 seconds over the FIA target.



#### Introduction

- These slides compare the results of the i20 ROPS test conducted by TRL to the prediction made by GRM of the result.
- GRM's prediction of the front roll bar displacement was 15mm and the test showed 16.8mm
- GRM's prediction of the main roll bar displacement was 76mm and the test showed 67.5mm
- The following slides show the very good agreement between the test deformation and the prediction.





## Front Rollbar

The model represents accurately the local deformation of the front roll bar where the load is applied.



### Front Rollbar

The model very clearly shows buckling in the corner of the roof diagonal locally where it meets the lateral roll bar, matching the test.





## Main Rollbar

Both the test and simulation show how the opposing forces in the roof and rear stay diagonals cause the main hoop to lose cross-

section.

#### Main Rollbar

The main hoop is bent forwards by the stiffness of the rear stay diagonals. This is very well represented by the simulation as is the local deformation caused by the platen.





GRM

## Main Rollbar

The roof diagonals buckle asymmetrically due to the pre-existing deformation from the front roll bar test. The simulation captures this effect very well.





- The simulation shows good prediction of the deformation which occurred in the front and main roll bar tests.
- Furthermore, the simulation shows excellent representation of the modes of deformation of the main roll cage tubes.





- We have become very good at understanding a manufacturers needs and also supporting them in design selection, design development and proposing appropriate solutions.
- In a tube structure, there are only so many brackets, tubes and fixing types that can be used, so we have to know which ones we can select to solve particular problems.
- Also, selecting cost-effective materials and keeping the design complexity down, so that again we can ensure that roll cages are easy to make.
- We also deliver a lot of test predictions, so we help people design structures that meet all the various load conditions before they commit to manufacture, tooling and subsequent testing.

## Conclusion



www.grm-consulting.co.uk

## Conclusion

- GRM has all the abilities and experience likely to be required by Motorsport UK in the simulation of ROPS for national approval.
- For any queries regarding this information, please contact:
  - Oliver Tomlin
  - oliver.tomlin@grm-consulting.co.uk
  - 07535 518908
  - 01926 889300

