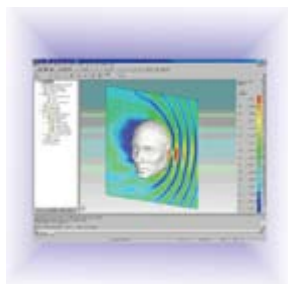# *fea*INFORMATION
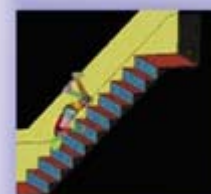
WWW.FEAINFORMATION.COM

Arup

Cellbond

Barrier Models

ESI Group

VA One 2007

Vibro-Acoustic

Analysis and Design

Dummy Diary

A Day in the Life

of a Dummy

FEA INFORMATION RESOURCE MAGAZINE

FEA Information Announcement:

AVI Library Additions Courtesy of
Li Zhang – Roller Hemming
G. Nilakantan – Person Falling Down Staircase

New Website: LS-DYNADEMO - **New Series**: The Dummy Diaries

LSTC ANNOUNCEMENT:

The 10th International LS-DYNA® Users Conference Call for Papers

Altair Announcement From Rick Battani

HyperWorks Technology Conference 2007 (HTC07)
October 2nd and 3rd at the Somerset Inn in Troy Michigan

ROI Announcement From elizabeth.freitas@roieng.com

A Day With Bence Gerber and ANSYS AUTODYN.

Oct 2, 2007 our Toronto Office, Tuesday,

Sincerely,

Art Shapiro   art@feainformation.com - **Editor**

Marsha Victory   mv@feainformation.com - **President**

www.feainformation.com   - www.ls-dynaconferences.com

Design Graphics: **Wayne L. Mindle**
Business Mgr: **Anthony Giaccana**

Table of Contents – September 2007

September Featured Paper

Fluid Structure Interaction for Immersed Bodies

Fluid Structure Interaction for Immersed Bodies

Jason Wang, Hao Chen

Livermore Software Technology Corporation,
7374 Las Positas Road, Livermore, CA 94551, U.S.A.

ABSTRACT

A new method for automatically constructing the coupling surface along shell edges is developed. By using this new "edge" option together with "shell thickness" option in the *CONSTRAINED_LAGRANGE_IN_SOLID card, we can accurately model problems involving shell structures with leading edges cutting into ALE materials. Engineering problems include bird striking at propulsion system fan blades; helicopter impacting water. This new feature is implemented in the latest LS-DYNA 971 release 7600 and ready to use with minor input deck modifications.

Before, in order to correctly model the FSI, blades had to be meshed by using Lagrange solid elements. This approach can ensure an accurate coupling interface but the time step size is greatly reduced due small element sizes. The lengthy running time for the problem makes this approach impractical. The new "edge" and "thickness" feature will construct a proper coupling surface from shell elements and provide reasonable time step sizes for the simulations.

Keyword:
Fluid structure interaction, Edge coupling, ALE

Featured AVI's – FEA Information AVI Library

Roller Hemming AVI's

301a 2.99MB Courtesy Li Zhang - LSTC

Roller hemming along a straight flange - pre-roller flanges the upstanding flange at an 45 degree angle and final roller completes the hemming process. Flange blank is held by deformable inner part at the top and rigid part (anvil) at the bottom. Breakdown wrinkles are visible

301 5.4MB Courtesy Li Zhang - LSTC

Mean stress contour animation of the same flange in roller hemming process viewed from another angle. Compressive stresses develop during movement of the pre-roller and followed by tensile stresses developed during movement of the final roller

301b 8.15 MBCourtesy Li Zhang - LSTC

The metal gathered around the edge of the disc as pre- and final rollers are going around the perimeter. Wrinkles around the edge is indicated by compressive mean stresses in red.

Person Falling Down a Staircase

60e 2MB Courtesy G. Nilakantan U of Delaware

Falls are the second leading cause of unintentional injury death for people in the United States. Falling down stairs is more prevalent for children (<14 years) and adults (>65 years). A person may fall down the stairs by tripping over an object lying on the staircase, by slipping on the step, even by missing the step altogether. Injuries range from bruises to broken limbs and serious falls include head trauma, post-traumatic amnesia, subdural haematoma and intracranial lesions. A broken neck can lead to instant fatality.

The presented AVI displays the use of LSDYNA to simulate a person falling down a staircase. A numerical dummy (50th percentile HYBRID III) is used to model the person. This type of simulation allows for the visualization of the contact interactions that occur between the person and staircase structure during the fall, as well as the trajectory of the fall for different scenarios. Injury assessment studies can be performed by extracting data from the dummy, such as contact forces and joint moments. By understanding the nature of the fall, staircases can be redesigned (e.g. rail height and projection from wall, stair depth to height ratio, width of staircase, chosen materials) and potential safety devices can be incorporated, to offer maximum cushioning and prevent any possible somersaulting of the person during the fall.

IMPLEMENTATION OF HEXAGONAL CLOSED PACKED METALS INTO LS-DYNA

DR. TOBIAS OLSSON

ENGINEERING RESEARCH NORDIC AB
Brigadgatan 16, 581 33 Linköping, Sweden
tobias.olsson@erab.se

This article describes the implementation of a material model for Hexagonal Closed Packed(HCP) metals. It constitutes a project carried out at Engineering Research Nordic AB on behalf of Livermore Software Technology Corporation. HCP metals are advanced materials and have a lot of excellent applications, i.e., HCP metals are important to many different industrial fields,ranging from Titanium biomedical implants to jet engine compressor components. Until to today most simulations of HCP metals are done with classical anisotropic models for cubic metals, so the need for an accurate model capable of capturing the asymmetries (tension versus compression), also known as the strength differential effect, is needed.

THEORY

The material model #233 (MAT_CAZACU_BARLAT) is aimed for modelling materials with strength differential and orthotropic behaviour under plane stress. The yield condition includes a parameter k that describes the asymmetry between yield in tension and compression. Moreover, to include the anisotropic behaviour the Cauchy stress deviator $\mathbf{S}$ undergoes a linear transformation. The principal values of the stress deviator are substituted with the principal values of a transformed stress tensor $\mathbf{Z}$, which is represented as:

$$\mathbf{Z} = \mathbf{CS}$$

where for orthotropic material the transformation tensor $\mathbf{C}$ is defined by

$$\mathbf{C} = \begin{pmatrix} c_{11} & c_{12} & c_{13} & & & \\ c_{12} & c_{22} & c_{23} & & & \\ c_{13} & c_{23} & c_{33} & & & \\ & & & c_{44} & & \\ & & & & c_{55} & \\ & & & & & c_{66} \end{pmatrix},$$

and for the case of plane stress the c_{55} and c_{66} are not used. That leaves us with 7 constitutive parameters to decide. Since the stress deviator and the transformation tensor are symmetric the transformed stresses are also symmetric. The eigenvalues of $\mathbf{Z}$ are denoted by $\Sigma_1, \Sigma_2, \Sigma_3$ and the yield condition is written

$$f(\Sigma_1, \Sigma_2, \Sigma_3, k, \varepsilon_{ep}) = \left(\left(|\Sigma_1| - k\Sigma_1 \right)^a + \left(|\Sigma_2| - k\Sigma_2 \right)^a + \left(|\Sigma_3| - k\Sigma_3 \right)^a \right)^{1/a} - \sigma_y(\varepsilon_{ep}) \le 0$$

where $a \ge 1$ and $k \in [-1,1]$. The stress limit is given by $\sigma_y(\varepsilon_{ep})$ and is dependent on the effective plastic strain. The parameter k present in the yield condition represents the strength differential effect in the material.

Different hardening laws are implemented. It is possible to choose from the following five laws:
The Swift hardening law
The Voce hardening law
The Gosh hardening law
The Hocket-Sherby hardening law
A loading curve, where the yield stress is given as a function of the effective plastic strain

PARAMETER IDENTIFICATION

There is possible to calculate the constitutive parameters from experimental data. The experiments that one need to be accomplished are tension and compression test in the 00 degree direction, tension test in the 45 degree direction, tension in the 90 degree direction and a balanced biaxial tension test. Since we are using 5 tests we need to reset two of the parameters. That means, when using the identification option the parameters c_{13} and c_{23} are set to zero. That leaves us 6 unknowns and 5 equations. To solve this problem we split it into many sub-problems were in each such sub-problem c_{12} is constant. The solution to the full problem is then chosen as the best sub-problem solution.

EXAMPLES

The first example shows the resulting contour plot for the yield surface given by the following fictitious experimental yield stresses

	σ_{00} [MPa]	σ_{45} [MPa]	σ_{90} [MPa]	σ_{Bi} [MPa]	σ_{00}^{c} [MPa]	
Exp. Data	633	333	433	471	333	
	c_{11}	c_{22}	c_{33}	c_{44}	c_{12}	k
Fitted data	0.0002	0.881	3.09	2.48	-0.969	-0.350

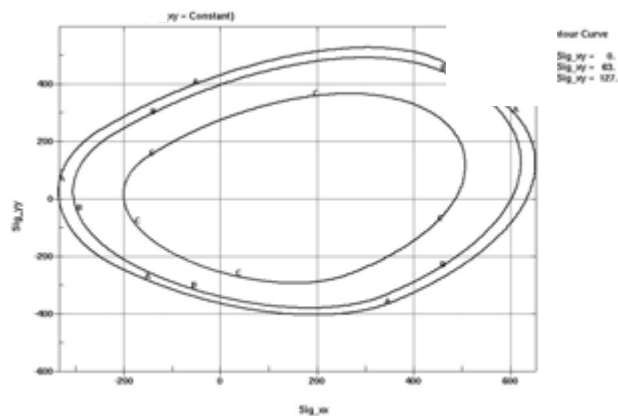**Table 1:** Fictitious experimental data and the fitted parameters

Figure 1: The resulting contour plot. Each curve represents constant shear stress.

The last example shows a forming simulation. The material parameters describe an aluminium-dioxide ($4Al-1/4O_2$) metal. The parameters are taken from Cazacu (2006) and are shown in Table 2.

c_{11}	c_{22}	c_{33}	c_{12}	c_{13}	c_{23}	c_{44}	k
1.000	1.042	0.883	0.218	0.364	0.375	0.000	-0.258

Table 2: Material parameters for the forming example, taken from Cazacu (2006) for $4Al-1/4O_2$

The initial configuration is shown in Figure 2a. A spherical cup is punched into a metal sheet to form a cup. The LS-DYNA simulation uses the keyword *CONTACT_SURFACE_TO_SURFACE for the contact between the rigid sphere and the plate. Since the problem is symmetric only one quarter of the geometry is modelled. Figure 2b shows the result after simulation. Note how the edges deform. The result is not as smooth as it would be in an isotropic simulation case and it is clear that the forming of an anisotropic material requires more pre-processing to obtain a more useful result.

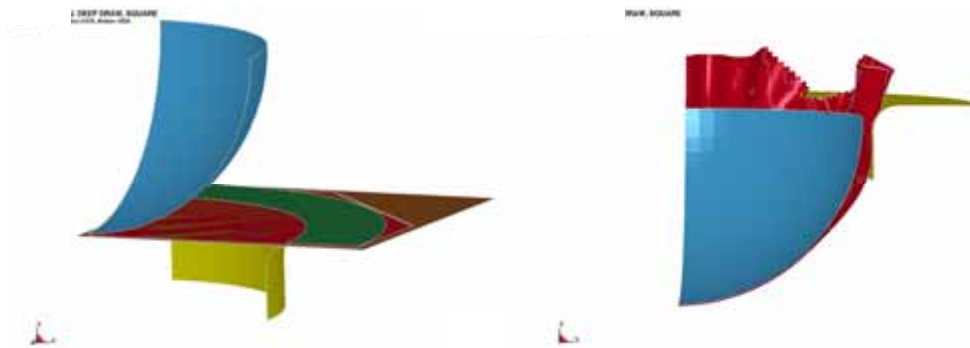**Figure 2:** The initial and final configurations of the forming example of a $4Al-1/4O_2$ metal sheet.

REFERENCES

Cazacu O., Plunkett B. and Barlat F., Orthotropic yield criterion for hexagonal closed packet metals, International journal of plasticity, 22, 1171-1194, 2006.

Arup-Cellbond Barrier Models
## © Copyright ARUP

Working in collaboration, Arup and Cellbond Composites Ltd have developed a range of LS-DYNA finite element models based on the aluminum honeycomb barriers produced by Cellbond Composites Ltd.

These models have been developed and validated using test data obtained from:

- Static and dynamic tests on honeycomb samples
- Adhesive strength testing
- Full barrier crash tests

These models were developed in the MPP version of LS-DYNA. They have also been tested in the SMP version and across a range of hardware platforms to ensure the performance and repeatability of results.

EEVC Offset Deformable Barrier (ODB) *NEW*
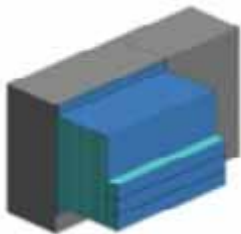
This barrier is used in the European frontal impact test and also in the Euro-NCAP consumer test. It consists of two different sized aluminium honeycomb blocks partially covered in aluminium sheets.

Advanced 2000 Side Impact Barrier

This barrier was developed by EEVC WG13 as the replacement for the Multi 2000 barrier and is used in the EU side impact regulation test. It is also used by Euro-NCAP in their side impact tests.

NHTSA Side & Rear Impact Barrier
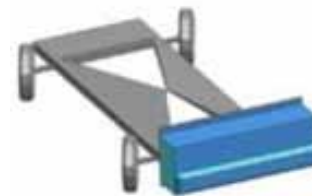
This barrier is used in the US federal regulation side and rear impact tests and also by NHTSA in their US-NCAP side impact tests.

IIHS Side Impact Barrier

This barrier is used by the IIHS in their side impact tests. The shape is designed to represent the front end geometry of a typical SUV or pickup.

Advanced European - Mobile Deformable Barrier (AE-MDB) Side Impact Barrier

This barrier is being developed by EEVC W13 and APROSYS as a replacement for the existing EEVC side impact barrier. The impactor is composed of six main honeycomb blocks that have been processed to give a progressive strength and a bumper honeycomb block.

Arup Contacts for Arup-Cellbond Barrier Models

UK - Hazel Partridge
Arup Group Ltd – UK
+44 (0) 121 213 3399
dyna.sales@arup.com

China - Kimbal Virdi
Arup Group Ltd – China
+86 (0) 21 6126 2875
china.support@arup.com

India - Lavendra Singh
nHance Eng. Solutions (P) Ltd
Indian Operation,
  - Oasys Ltd (Arup)
+91 (0) 40 235 444 20
lavendra.singh@arup.com

USA - Simon Iregbu
Arup Group Ltd – Detroit
+1 248 822 5050
us.support@arup.com

Other Worldwide Distributors of Arup-Cellbond Barriers Models:

Alyotech (France) –
www.alyotech.fr
Dynamore (Germany) –
www.dynamore.de
ERAB (Scandinavia) –
www.erab.se
JRI Solutions Ltd (Japan) –
www.jri-sol.co.jp
THEME Engineering (Korea) –
www.lsdyna.co.kr

Intel Demonstrates Industry's First 32nm Chip and Next-Generation Nehalem Microprocessor Architecture -

INTEL DEVELOPER FORUM, San Francisco, Sept. 18, 2007 – Intel Corporation President and CEO Paul Otellini today outlined new products, chip designs and manufacturing technologies that will enable the company to continue its quickened pace of product and technology leadership.

Speaking to industry leaders, developers and industry watchers at the Intel Developer Forum (IDF), Otellini showed the industry's first working chips built using 32 nanometer (nm) technology, with transistors so small that more than 4 million of them could fit on the period at the end of this sentence. Intel's 32nm process technology is on track to begin production in 2009.

Otellini also described the near-term advantages computer users will experience with Intel's upcoming 45nm family of Penryn processors, which are based on its revolutionary high-k metal gate transistor technology. The industry's first 45nm processors will be available from Intel in November. The company also demonstrated for the first time the next-generation chip architecture codenamed Nehalem, due out next year.

"Our tick-tock strategy of alternating next generation silicon technology and a new microprocessor architecture -- year after year -- is accelerating the pace of innovation in the industry," said Otellini. "Tick-tock is the engine creating today's most advanced technologies and keeps them coming out at a rapid cadence. Our customers and computer users around the world can count on Intel's innovation engine and manufacturing capability to deliver state-of-the-art performance that rapidly becomes mainstream."

When Intel introduces Penryn in November, it will be the world's first high-volume 45nm processor. Penryn, along with the Silverthorne family of 45nm processors (available next year) will have the small feature size, low-power requirements and high-performance capabilities to meet a wide variety of computing needs from handheld Internet computers to high-end servers. Intel will quickly ramp the technology with plans to introduce 15 new 45nm processors by the end of the year and another 20 in the first quarter of 2008, extending Intel's leadership in product performance and energy efficiency. Intel has already achieved more than 750 design wins for the Penryn processor.

"We expect our Penryn processors to provide up to a 20 percent performance increase while improving energy efficiency," said Otellini. "Intel's breakthrough 45nm silicon process technology allows us to provide low-cost, extremely low-power processors for innovative small form factor devices while delivering high-performance, multi-core, multi-featured processors used in the most advanced systems."

Otellini also announced that Intel's 45nm processors and 65nm chipsets would use halogen-free packaging technology beginning in 2008. The result will be that Intel's 45nm processors will not only be more energy efficient but also better for the environment.

Looking to 2008, Otellini made the first public demonstration of Intel's Nehalem processor and said the company is on track to deliver the new processor design in the second half of the year. The Nehalem architecture will extend Intel's leadership in performance and

performance-per-watt benchmarks, and will be the first Intel processor to use the QuickPath Interconnect system architecture. Quickpath will include integrated memory controller technology and improved communication links between system components to significantly improve overall system performance.

"Nehalem is an entirely new architecture that leverages Intel's Core Microarchitecture, bringing leading-edge performance advantages, power efficiency and important new server features to market just a year after Intel leads the industry to 45nm technology," said Otellini.

Describing other advanced Intel technologies destined to quickly come to market, Otellini showed the world's first 300mm wafer built using next-generation 32nm process technology. The development of advanced test chips serves as a critical milestone in the company's march toward high-volume manufacturing of 32nm process technology. With plans to introduce processors built on 32nm technology in 2009, Intel will maintain its industry lead delivering the most advanced manufacturing technologies.

Intel's 32nm test chips incorporate logic and memory (static random access memory --SRAM) to house more than 1.9 billion transistors. The 32nm process uses the company's second-generation high-k and metal gate transistor technology.

This additional performance made possible by Intel's push to drive chip design and manufacturing technology forward will not only be seen in computing, but will enable more true-to-life entertainment and realistic graphics capabilities. As a result, the company said it will be placing increased emphasis

on using the power of its processors to enhance key technologies such as visual computing and graphics.

"Satisfying demand for ever-greater computer performance increases means we need to move rapidly to the next manufacturing technology." said Otellini. "Intel engineers and researchers deserve a great deal of credit for setting the pace for the industry. As our advanced technology reaches consumers and businesses in the next couple of years the amount of computing power they'll be able to harness will help them become even more productive, creative and innovative."

Otellini also announced that a version of a Penryn dual-core processor operating at 25 watts will be available on the upcoming Montevina platform, which will include Intel's mobile WiMAX silicon. Several equipment manufacturers are already planning to introduce Montevina-based notebook PCs starting next year when the platform is introduced. Overall, WiMAX is expected to reach more than 1 billion people worldwide by 2012.

The reach of WiMAX along with Intel's efforts to bring computing technology to developing nations through the World Ahead program and innovative products such as the Silverthorne processor will help bring computing to the next billion people worldwide according to Intel.

For more news coverage out of IDF, visit the complete press kit at www.intel.com/pressroom/idf.

About Intel

Intel, the world leader in silicon innovation, develops technologies, products and initiatives to continually advance how people work and live. Additional information about Intel is available at www.intel.com/pressroom and blogs.intel.com.

ESI Group releases VA One 2007:
The ONE Simulation Environment
for Vibro-Acoustic Analysis and Design

Isabelle Girard at isabelle.girard@esi-group.com
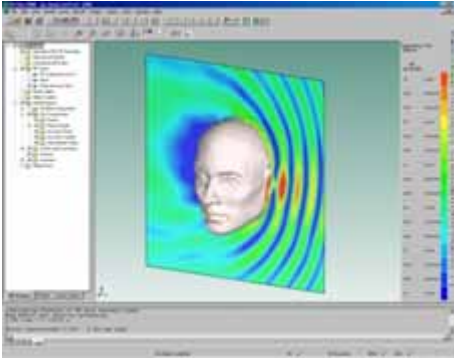
VA One environment

Photo credits: ESI Group

Paris, France, September 20th 2007 - ESI Group, a world-leading company committed to delivering state-of-the-art simulation software for vibro-acoustic analysis and design, is pleased to announce the release of VA One 2007. VA One is the next generation of ESI Group's vibro-acoustic analysis software and provides a complete solution for simulating the response of vibro-acoustic systems across the entire frequency range. The software enables optimal noise and vibration performance to be accounted for at the design stage, and ensures that noise and vibration specifications can be met without adding extra cost and weight.

"*VA One is a real leap forward when it comes to acoustical modeling technologies and is likely to set the standard for industrial computational acoustics of large structures for the future. The innovative integration of Finite Elements (FE) and Statistical Energy Analysis (SEA) methods within one model allows the user to solve problems that cannot be addressed by applying SEA or FE methods separately*" says Ulf Orrenius, Senior Specialist:

Acoustics and Vibration, Bombardier Transportation.

VA One seamlessly integrates AutoSEA2, the industry standard software for mid and high frequency noise and vibration analysis, and Rayon, a proven solver for low frequency vibro-acoustic analysis. In addition, VA One contains patented technology for rigorously coupling the Finite Element Method (FEM), the Boundary Element Method (BEM) and SEA in a single analysis. VA One is the only simulation solution on the market that covers the complete spectrum of vibro-acoustic analysis in one easy-to-use environment.

"*This new release of VA One significantly enhances the performance of our core solvers and expands the types of problems that can be addressed with vibro-acoustic simulation. The new functionalities will enable our users to create more realistic models of noise and vibration performance and improve productivity by reducing the time spent creating and solving models.*" says Phil Shorter, Director of VA Product Operations, ESI Group.

The VA One 2007 release contains 35 major enhancements including: faster solution times for SEA and BEM models, support for the Windows VISTA and LINUX operating systems, and new functionality for creating fast and accurate models of grommets, leaks, apertures and grillages.

To obtain additional information about our vibro-acoustics software, please contact our VA Marketing Specialist, Isabelle Girard at isabelle.girard@esi-group.com

About ESI Group's Vibro-acoustics Solutions

VA One, the ONE simulation environment for full-frequency vibro-acoustic analysis and design (the evolution of the AutoSEA2 and Rayon codes).

VTM (Vehicle Trim Modeler), software for low frequency sound package design.

NOVA and FOAM-X, software for the simulation and characterization of multi-layered acoustic treatments.

About ESI Group

ESI Group is a world-leading supplier, and a pioneer of digital simulation software for prototyping and manufacturing processes that take into account the physics of materials. ESI Group has developed an extensive suite of coherent, industry oriented applications to realistically simulate a product's behavior during testing, to fine-tune manufacturing processes in accordance with desired product performance, and evaluate the environment's impact on product performance. ESI Group's products, which have a proven track record in manufacturing and have been combined in multi-trade value chains, represent a unique collaborative and open virtual engineering solution known as the Virtual Try-Out Space (VTOS), enabling virtual prototypes to be improved in a continuous and collaborative manner. This integrated protocol allows all the company's solutions to work with each other and with applications developed by independent software vendors. By significantly reducing costs and development lead times and enabling product/process synergies, VTOS solutions offer major competitive advantage by progressively eliminating the need for physical prototypes during product development. The company generated sales of €66m in 2006, employs over 600 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in Eurolist compartment C of Euronext Paris. For further information, visit www.esi-group.com.

ESI Group - Press Relations

Nathalie David-Franc

nathalie.david-franc@esi-group.com

Phone : + 33 (0)1 41 73 58 35
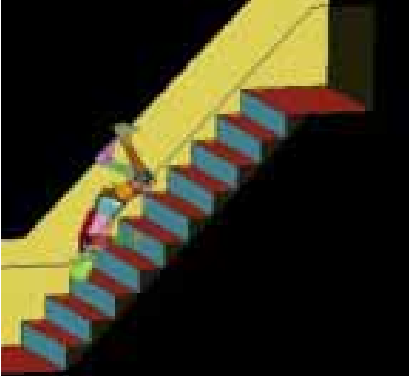
A Day In The Life of a Dummy - Diary 1
© A. Dummy, Sr.

I'm a Dummy in the engineering field and always wanted a diary of my workday.
Along with my Dummy co-workers I'd like to share our normal workday. We try to keep
our hours to an eight-hour workday. At times, we have to keep doing the same routine
over and over. Although this does get tedious, our goal and vision is to make
mainstream life safer. I hope to write more in the coming months and share with you
our many experiences during our normal working day.

Dear Diary,

Today we found ourselves flying over seats, and vehicle hoods.   As we were about to go
home a fellow Dummy, and one I know very well, fell down a staircase.   All in all it was
a Productive Dummy Day, or as I say in our industry a PDD (Productive Dummy Day).

	AVI #	Description
	23 762KB	**Airplane**
	23a 1.43MB	**Pedestrian impacting vehicle hood**
	60e 2MB	**Falling down staircase**

ERAB Announcement

Dr. Jan Brandt, LS-DYNA Specialist

It is with the deepest regret I have to inform you that Dr. Jan Brandt has passed away.

Jan Brandt was born in Malmo, Sweden, in 1949. He received his Master of Science in Physical Engineering from Lund University in 1976 and his Ph.D. in Solid Mechanics from Linkoping University in 1998 with me as his supervisor. His Ph.D. thesis concerns the constitutive modeling of hard metal powder, both during the compaction process and the subsequent sintering process. His material model is implemented into LS-DYNA and is used in product development runs by Sandvik Coromant AB.

Larsgunnar Nilsson
President, Engineering Research AB

Jan Brandt has been involved in LS-DYNA matters since 1985, when LS-DYNA was introduced at Saab Aircraft. He has regularly and frequently been using LS-DYNA since the late 1980's in many, often advanced and complex, projects as an independent consultant of Ingenjorsdata AB. At the time of his death he was working on the solution of bird strike and containment problems at Volvo Aero AB.

We remember Jan Brandt as an advanced specialist, colleague, client and dear friend.

Featured Worldwide Guest Company - IRAN

MEHDICO Design/ simulation/ manufacturing services

Acting locally - Thinking Globally

Iran is an under development wide country with the great opportunities for foreigners for investment.

Profitable projects in the following fields ready to investment:

- Energy
- Car Indsutry
- Civil Building
- Electric-Water, Electronics & IT

E-mail: info@mehdico.com **- Phone: +98 912 1276408**

SERVICES

Design & Engineering: Product design, engineering & development. designing & manufacturing the other tools like die, fixture & special machines. simulation before manufacturing.

طراحی مهندسی: طراحی مهندسی و ساخت محصول، قالب، فیکسچر, ماشین مخصوص و قطعه طبق سفارش. با استفاده از آخرین فن آوری روز و امکان شبیه سازی قبل از ساخت.

Trading: we are your partner for investment in Iran. Finance. import & export services.

بازرگانی: مشاوره سرمایه گذاری، واردات و صادرات.

Computer: Enterprise programming. hardware/ software/ internet.

کامپیوتر: برنامه نویسی و خدمات حرفه ایی در زمینه نرم افزار، سخت افزار و اینترنت

Products

High quality manufacturing/ assembly services with the lowest price

- Die manufacturing.
- [Mold](#) manufacturing.
- Part manufacturing.
- Assembly services.
- Welding.

- ساخت قالب، فیکسچر، ماشین مخصوص
- تولید قطعات فلزی و پلاستیکی و دایکست.
- ارائه خدمات مونتاژ و ماشین کاری.
- جوش کاری قوس الکتریکی، جوش MIG، جوش 2Co,TIG.

Among the MSC.Software Corporation's 2007 VPD Conferences
October 2007 – US, Europe, Middle-East, & Africa

MSC.Software Corporation's 2007 Americas VPD Conference: Gaining Competitive Advantage through Engineering Productivity

For Complete Information

Americas Conference Information:
Marriott at the Renaissance Center
Detroit, Michigan
October 11-12, 2007

MSC.Software's driving mission is to help you and your company improve your product development process. This conference is dedicated to providing you with the latest information on the strategies and technologies that you can use immediately to enhance concept development, design, simulation, testing, manufacturing, and business performance.

This is the only industry conference that explores all aspects of virtual product development. Join nearly 700 engineers and senior executives from industries including automotive, aerospace, bio-medical, civil engineering, defense, and general machinery. You'll discover how other industry leaders are improving communication and collaboration in their product design and manufacturing processes to accelerate time and right to market. MSC.Software management and experts will also be available to discuss your requirements in relation to your current and future product development needs. They'll provide insight into how you can improve product performance and reliability by enhancing product simulation, testing, and manufacturing.

Attend the 2007 VPD Conference and you'll have the opportunity to network with colleagues in your field, hear from industry leaders such as Whirlpool, Chrysler North America, Dura Automotive Systems, Eaton Corporation, Embraer, Energizer Battery, Ford Motor Company, General Dynamics Land Systems, General Motors, Kimberly-Clark Corporation, L-3 Communications Integrated Systems, Lockheed Martin and Spirit AeroSystems on the evolution of simulation in the enterprise, and learn how MSC.Software's new enterprise solution strategy will help you meet the ever-increasing pressures of time, cost, quality, and performance.

Join us and you'll be better equipped to:

Maximize the return on your Enterprise Simulation investment

Ensure right-to-market for your products

Minimize time-to-market for your products

MSC Software Virtual Product Development (VPD) Conference, 2007

Europe, Middle-East, & Africa (EMEA)
17-18 October, 2007 *(arrival 16-October)*
The Radisson SAS Hotel, Frankfurt Germany

[Complete Information]

Why Attend

Today's manufacturing landscape is intensely shaped by competition, and achieving or maintaining competitive advantage is typically reported as the #1 challenge facing engineering organisations. Success may include bringing products to market more quickly, at lower cost, or by gaining greater acceptance through enhanced product performance or new levels of included innovation.

Conference Objectives

MSC.Software's Virtual Product Development Conference 2007 is the premier gathering for all executives, managers, engineers and designers who are actively seeking Gaining Competitive Advantage through Engineering Productivity.

Our agenda is dedicated to the Technologies and Processes of Virtual Product Development, providing a consolidated review of the simulation environments available today, and a perspective of trends and developments over the next 12 months. Our aim is to celebrate the best in industrial applications, simulation process management, and design innovation from the VPD community.

Participants Benchmarks on TopCrunch
08/12/2007 – 09/18/2007 TopCrunch.org

Benchmarks of the 1.9 GHz AMD Barcelona for systems from IBM and Scali are now available on Top Crunch. These first benchmarks are for 1 and 2 node systems (4 and 8 cores total) for the Three Car Collision and Neon Revised benchmark problems.

HP/HP

Vendor Submitter	Computer/ Interconnect	Processor	#Nodes x #Processors per Node x #Cores Per Processor = Total #CPU	Time (Sec)	Benchmark Problem	Submit Date
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	8 x 2 x 2 = **32**	473	neon_refined_revised	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	4 x 2 x 2 = **16**	815	neon_refined_revised	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	2 x 2 x 2 = **8**	1528	neon_refined_revised	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	1 x 2 x 2 = **4**	2995	neon_refined_revised	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	1 x 1 x 2 = **2**	4482	neon_refined_revised	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	8 x 2 x 2 = **32**	5778	3 Vehicle Collision	08/23/2007

HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	16 x 2 x 2 = **64**	5778	3 Vehicle Collision	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	4 x 2 x 2 = **16**	10796	3 Vehicle Collision	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	2 x 2 x 2 = **8**	20367	3 Vehicle Collision	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	16 x 2 x 2 = **64**	28675	car2car	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	1 x 2 x 2 = **4**	39472	3 Vehicle Collision	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	8 x 2 x 2 = **32**	51974	car2car	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	4 x 2 x 2 = **16**	98384	car2car	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	2 x 2 x 2 = **8**	190423	car2car	08/23/2007
HP/HP	CP3000/ConnectX	Intel Dualcore Xeon 3.0 GHz BL460c	16 x 2 x 2 = **64**	337	neon_refined_revised	08/24/2007

Participants Benchmarks on TopCrunch

TopCrunch.org for complete Vendor submitted benchmarks

IBM/IBM –

Vendor/ Submitter	Computer/ Interconnect	Processor	#Nodes x #Processors per Node x #Cores Per Processor = Total #CPU	Time (Sec)	Benchmark Problem	Submit Date
IBM/IBM	X 3455/shared memory	AMD Barcelona 1.9 GHz	1 x 2 x 4 = **8**	1940	neon_refined_revised	09/18/2007
IBM/IBM	System X 3455/shared memory	AMD Barcelona 1.9 GHz	1 x 1 x 4 = **4**	3167	neon_refined_revised	09/18/2007
IBM/IBM	System X3455/shared memory	AMD Barcelona 1.9 GHz	1 x 2 x 4 = **8**	27020	3 Vehicle Collision	09/18/2007
IBM/IBM	System X3455/shared memory	AMD Barcelona 1.9 GHz	1 x 1 x 4 = **4**	42358	3 Vehicle Collision	09/18/2007

Employment Opportunity – Location – United States

© Mike Pinellas, MEMS Investor Journal - mike@memsjournal.com

Wanted: ANSYS and LS-DYNA Expert
Location: United States

Do you love to work with ANSYS and LS-DYNA? Have you been doing it for 3-7 years? This job will allow you to showcase your skills, while learning new modeling techniques.

Benefits include:

- Extremely competitive salary plus **stock options** and full benefits
- Learn and develop your expertise with **exciting projects**
- Good opportunity for **career advancement**

Requirements:

- 3-7 years of **modeling experience in ANSYS** (required)
- **LS-DYNA** experience (major plus)
- **Mechanical engineering** background (plus)
- **MEMS or sensors** background (plus)

To apply

Please email your resume to recruiting@memsjournal.com.

Our client is a rapidly growing startup which recently raised $15 million in venture capital.

For more information, please go to

http://www.memsinvestorjournal.com

or email Mike Pinelis:

mike@memsjournal.com

LS-DYNA® at the 25th CADFEM Users´ Meeting

November 21 – 23, 2007, Dresden, Germany - www.usersmeeting.com

CADFEM has announced the preliminary LS-DYNA program at this year´s CADFEM Users´ Meeting. The CADFEM Users´ Meeting will be held simultaneously to the German ANSYS Conference. In 2007, the ANSYS Conference & 25th CADFEM Users' Meeting will be one of the most comprehensive expert conferences on numerical simulation in product development in Europe.

LS-DYNA at the 25th CADFEM Users´ Meeting – preliminary agenda:

Wednesday, November 21, 2007

Keynote:

Future Technology Outlook

J. Hallquist (Livermore Software Technology Corporation, Livermore, CA, USA)

LS-DYNA Session:

Technical Remarks Part I

J. Hallquist (Livermore Software Technology Corporation, Livermore, CA, USA)

ALE and FSI Capabilities in LS-DYNA - New Corpuscular Method for Airbag Deployment Simulations

L. Olovsson (Livermore Software Technology Corp., Livermore, CA, USA, IMPETUS Afea, Huddinge, Sveden)

Neuigkeiten zu LS-DYNA bei CADFEM

U. Stelzmann (CADFEM GmbH, Chemnitz), M. Hörmann (CADFEM GmbH, Grafing)

SPH - New Developments and Applications

J. Lacome (Livermore Software Technology Corporation, Livermore, CA, USA)

Thursday, November 22, 2007

LS-DYNA Session:

Aktueller Stand und neue Trends aus Anwendersicht

U. Stelzmann (CADFEM GmbH, Chemnitz), M. Hörmann (CADFEM GmbH, Grafing)

Simulation von Klebeverbindungen zwischen Stahlblechen unter Crashbeanspruchung im Automobilbau mit der Methode der Finiten Elemente

M. Brede (Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung, Bremen)

Auslegung eines Crashdeformationselementes einer Sicherheitslenksäule mittels numerischer Simulation

K. Plangger (ThyssenKrupp Presta AG, Eschen, Liechtenstein)

FAT-Richtlinie: Dynamische Werkstoffkennwerte für die Crashsimulation

W. Böhme (Fraunhofer Institut für Werkstoffmechanik, Freiburg)

Parameter Identification for the Simulation of Debonding in Honeycomb Sandwich using LS-DYNA

M. Hörmann (CADFEM GmbH, Grafing)

ANSYS & LS-DYNA Simulation of Electronic Modules Subjected to Free Drop Test

P. Gromala (Qimonda Dresden GmbH & Co. oHG, Dresden)

Johnson-Cook Model Parameter Identification: Some Observations Illustrated with Aluminium 6063-T6

L. Schwer (Schwer Engineering & Consulting Services, Windsor CA, USA)

Technical Remarks Part II

J. Hallquist (Livermore Software Technology Corp., Livermore, CA, USA)

N.N.

T. Dutton (Dutton Simulation Ltd., Warks, United Kingdom)

Übertragung von Umformergebnissen in die Crashsimulation zur Verbesserung der Vorhersagequalität

U. Scholl (Fraunhofer Gesellschaft SCAI, Sankt Augustin)

Simulation eines zellularen Verbundwerkstoffes für Crashanwendung

F. Bartl, R. Dallner (Fachhochschule Ingolstadt)

Test Verification Techniques in LS-DYNA

U. Jankowsi, M. Müller-Bechtel, J. Martinez (TECOSIM GmbH, Rüsselsheim)

LS-OPT based Identification of a User Defined Material Model for Distortional Hardening with Application to Sheet Forming Processes with Complex Strain Path Changes

V. Levkovitch, B. Svendsen (Universität Dortmund)

Robustheitsbewertungen von Crashberechnungen mit LS-DYNA und optiSLang

J. Will (Dynardo GmbH, Weimar), U. Stelzmann (CADFEM GmbH, Chemnitz)

An Overview of the ASME Guide for Verification and Validation in Computational Solid Mechanics

L. Schwer (Schwer Engineering & Consulting Services, Windsor CA, USA)

Simulation des Druckanstiegs in der Tür beim Seitencrash mittels Fluid-Struktur-Interaktion

M. Machens (Wilhelm Karmann GmbH, Osnabrück)

Friday, November 23, 2007

Technical Workshop I

New Features in LS-DYNA 971 & Tips and tricks for contacts and composites

U. Stelzmann (CADFEM GmbH, Cemnitz), M. Hörmann (CADFEM GmbH, Grafing)

Technical Workshop II

Optimization and robustness using LS-OPT & Simulation of bonded joints

W. Lietz (CADFEM GmbH, Dortmund), A. Matzenmiller (Universität Kassel)

The program dedicated to LS-DYNA will be embedded in one of this year´s most comprehensive expert conferences. 800 or even more engineers are expected to attend the event with a special emphasis on structural mechanics, computational fluid mechanics and fluid-structure-interaction. It will be accompanied by a large CAE exhibition with probably more than 40 companies.

So LS-DYNA users benefit twice from attending the conference: They take advantage of an effective and detailed technical content on LS-DYNA, AND additionally, they have access to a broad variety of complementary CAE information!

More information:
www.usersmeeting.com

LS-DYNA, LS-OPT, and LS-PrePost are registered trademarks of Livermore Software Technology Corp..

The LS-DYNA® Italian Users' Meeting

Direct participation by LSTC

For Complete Conference Information and products: EnginSoft S.p.A

modeFRONTIER™ - ANSYS Workbench - ANSYS CFX - ANSYS ICEM CFD Magmasoft - LMS Virtual.Lab - Moldflow's Design Analysis Solutions – AdvantEdge - FORGE2 and FORGE3

LS-DYNA®, LS-OPT®, LS-PrePost®

EnginSoft's annual Meeting will be hosted in the elegant Villa Caroli-Zanchi, near Stezzano/Bergamo, on 25th and 26th October 2007.

The next edition of the LS–DYNA Italian Users' Meeting will adopt a totally new spirit. "Priority and Challenges" viewpoint and motto by EnginSoft will characterize this year's LS-DYNA Italian Users' Meeting. The leading principle will be shaped in the many presentations by the LS–DYNA users.

Last year's edition of the LS–DYNA Italian Users' Meeting had been a successful one, in terms of both interest and attendance. The success built upon the rich programme of technical presentations and agenda. The agenda and direct participation of LSTC allowed users attending the meeting to acquire information, knowledge and innovative experiences from many different industry, educational and research sectors.

This year's edition of the LS–DYNA Italian Users' Meeting, aims at repeating its past success. This year users will find a broader presentation agenda and support for the growing technical interest

in LS-DYNA, the foremost numerical code, specifically developed for the resolution of complex non-linear dynamic problems of real phenomena.

The 2007 programme, besides several contributions about application examples and industrial cases, will offer a technical update seminar on specific methodologies and software tools regarding LS-DYNA applications. The event will be the ideal occasion to convey an overview of the state-of-the-art and in depth study of solutions and analysis routines.

This event targets knowledge and routine transfer. Therefore, the present invitation is addressed, besides LS-DYNA Italian users, to anyone dealing with rapid dynamics problems, involving deformations, sophisticated material models and complex contact conditions, which are typical of impact problems and metal forming

LS-DYNA® Discussion Group
at 78th Shock & Vibration Symposium
November 6th, 2007

An informal LS-DYNA Discussion Group will be held on Tuesday 6 November from 17:30 to 19:00 in conjunction with the 78th Shock & Vibration Symposium. (www.saviac.org)

The Discussion Group will feature a presentation by Dr. Tom Littlewood on new and improved under water explosion (UNDEX) capabilities of LS-DYNA.

This meeting is an opportunity for engineers to meet with Livermore Software Technology Corporation (LSTC) personnel, learn of recent developments in LS-DYNA and LS-PrePost, discuss application of LS-DYNA to their problems, share best practices, and make requests for new features.

The meeting is hosted by Livermore Software and Technology Corporation (LSTC) and moderated by Dr. Len Schwer of Schwer Engineering & Consulting Services. You may contact Len (Len@Schwer.net) for more information, comments, or suggestions.

About The annual Shock and Vibration Symposium:

The annual Shock and Vibration Symposium is the leading forum for the structural dynamics and vibration community to present and discuss new developments and on-going research. The Symposium was established in 1947 and includes both classified and unclassified sessions. The classified sessions allow critical technology and classified (up to secret level) research to be presented in closed forums of cleared US Government and government-contractor researchers. Topics covered at the symposium include shock-ship testing, water shock, weapons effects (air blast, ground shock, cratering, penetration) shock physics, earthquake engineering, structural dynamics, and shock and vibration instrumentation and experiment techniques. Over 200 technical papers are typically presented. Panel discussions address topics such as new software developments or accelerometer isolation problems. Tutorials provide up-to-date technology overviews by leading specialists

The 10th International LS-DYNA® Users Conference

June 8-10, 2008

Hosted by Livermore SoftwareTechnology Corp. (LSTC)

To be held at The Hyatt Regency Dearborn, MI

Abstract Deadline:
Dec. 5, 2007

email your abstract to:
papers@lstc.com

Notification: 01/27/08

Paper Deadline: 03/07/08

Conference Papers: The presenter of each accepted paper will receive free admission to the conference, provided that the presenter registers for a room at the Hyatt Regency Dearborn under LSTC Conference

. **Application Areas Being Accepted for Paper Submission:**

- Aerospace
- Automotive Crashworthiness
- Ballistic and Penetration
- Biomechanics
- Civil Engineering
- Compressible Fluid Dynamics
- Electro Magnetics

- Heat Transfer
- Impact and Drop Testing
- Manufacturing Processes
- Metal Forming
- Modeling Techniques
- Nuclear Applications
- Occupant Safety

- Seismic Engineering
- Ship Building
- Transportation
- Virtual Proving Ground

Abstract Length: Approximately 300 words, please include figures, if possible

Paper Length: Maximum of 3000 words, single-spaced, on 8-1/2" x 11" paper

Format: A MS Word template will be provided

Contact: papers@lstc.com

_____

Livermore Software Technology Corp.
(925) 449-2500
www.lstc.com
www.ls-dynaconferences.com

LSTC California & Michigan Training Classes

A complete list of dates can be found on the <u>LSTC</u> website

<u>Class Registration Form (PDF Format)</u>

October
  18-19   CA   Concrete and Geomaterial Modeling
  22-25   MI   Introduction to LS-DYNA

November
  12-15   CA   Introduction to LS-DYNA
  27-30   CA   Introduction to LS-OPT

December
  10-11   MI   Contact
  12-13   MI   Implicit

For Complete Class Details:

<u>www.lstc.com</u>

2007/2008 Worldwide Events

Oct 11-12	**German LS-DYNA Forum** **Frankenthal, Germany, hosted by DYNAmore Call for papers (pdf)**
Oct 24-25	**SIMULATION OF MANUFACTURING PROCESSES AND MATERIAL FORMING** **"Simulation, a primary development tool in the automotive industry" Ocober 24 & 25, 2007 - CAEN**
Oct 25-26	**LS-DYNA Italian Users' Meeting will take place next October during the Annual EnginSoft Users' Meeting**
Oct 30-31	**Japan LS-DYNA Users Conference** **hosted by JRI**
Nov 05	**12th Korean LS-DYNA Users Conference** **hosted by THEME**
Nov 21 - 23	**CADFEM Users´ Meeting 2007** **Dresden, Germany, hosted by CADFEM**
Dec 5-7	**China International Simulation Industry Exhibition & Conference** **–** **Shanghai, China**
Dec.6-8	**The 3rd Auto Engineers Conference & "Industry Design and R&D Session"**
Events 2008	
April 28-29	**2008 VR&D Users's Conference**
June 8-10	**10th International LS-DYNA Users' Conference -The Hyatt Regency, Dearborn, MI, US -hosted by LSTC**
May, 28-30	**The 4th International Conference on Advances in Structural Engeering and Mechanics(AWAS'08)** **in Jeju, Korea**

FEA Information China Participants

Arup China: LS-DYNA sales, support, training	Name: Li YuQiang Email: Yu-qiang.li@arup.com Tel 021 5396 6633 extn 151
Tsinghua University	Qing Zhou, PhD. – Professor Department of Automotive Engineering Beijing, 100084, China
Engineering Technology Associates (China) Inc.	Martin Ma Tel: + 86-21-64385725 Contact: support@eta.com.cn

China Company Listings

Ansys-China, Inc.	Tel: 86-10-84085558 Website: www.ansys.com.cn Contact: China@ansys.com.cn
Hewlett-Packard Asia Pacific Ltd.	Jerry Huang Tel: +86-10-65645261 Contact: J.Huang@hp.com
IBM China	Ms. Ling WANG - Tel: +86-10-6539-1188 x4463 (T/L:901-4463) Website: http://www.ibm.com/cn/ Contact: wangling@cn.ibm.com
MSC. Software Corp.	Tel: +86-10-6849-2777 Website: www.mscsoftware.com.cn Contact: mscprc.contact@mscsoftware.com
SGI China	Carl Zhang Tel: +86 -10 - 65228868 Ext. 3362 Contact: carl@sgi.com
Zhong Guo ESI Co., Ltd	Yang Xiaojum Phone: +86 (020) 8235 6272 Contact : Yang Xiaojun

Engineer's Market Place

LifeBook E Series notebook	LifeBook T3000 Notebook
Fujitsu LifeBook T4215 Notebook	New Fujitsu LifeBook® Q Series Notebook PC
New Fujitsu LifeBook® T4210 Tablet PC	New Fujitsu LifeBook® S7110 Notebook
New Fujitsu LifeBook® E8210 Notebook	New Fujitsu LifeBook® N3530 Notebook

BOOKS Available at Amazon

The Finite Element Method: Linear Static and Dynamic Finite Element Analysis -Thomas J.R. Hughes (Sept. 2000)

Vibration Simulation Using MATLAB and ANSYS - Michael R. Hatch -(Sept. 2000)

Nonlinear Finite Element Analysis for Continua and Structures
     Ted Belytschko, et al/Hardcover/Published 2000

Nonlinear Finite Element Analysis for Continua and Structures
     Ted Belytschko, et al/Paperback/Published 2000

LS-DYNA Resource Page

FEA Information Inc. Participant's (alphabetical order)

Fully QA'd by Livermore Software Technology Corporation

TABLE 1: SMP	
AMD Opteron	Linux
FUJITSU Prime Power	SUN OS 5.8
FUJITSU VPP	Unix_System_V
HP PA-8x00	HP-UX 11.11 and above
HP IA-64	HP-UX 11.22 and above
HP Opteron	Linux CP4000/XC
HP Alpha	True 64
IBM Power 4/5	AIX 5.1, 5.2, 5.3
IBM Power 5	SUSE 9.0
INTEL IA32	Linux, Windows
INTEL IA64	Linux
INTEL Xeon EMT64	Linux
NEC SX6	Super-UX
SGI Mips	IRIX 6.5 X
SGI IA64	SUSE 9 with ProPack 4 Red Hat 3 with ProPack 3
SUN Sparc	5.8 and above
SUN Opteron	5.8 and above

TABLE 2: MPP and MPI Interconnect			
Vendor	O/S	HPC Intereconnect	MPI Software
AMD Opteron	Linux	InfiniBand (SilverStorm), MyriCom, QLogic InfiniPath	LAM/MPI, MPICH, HP MPI, SCALI
FUJITSU Prime Power	SUN OS 5.8		
FUJITSU VPP	Unix_System_V		
HP PA8000	HPUX		
HPIA64	HPUX		
HP Alpha	True 64		
IBM Power 4/5	AIX 5.1, 5.2, 5.3		
IBM Power 5	SUSE 9.0		LAM/MPI
INTEL IA32	Linux, Windows	InfiniBand (Voltaire), MyriCom	LAM/MPI, MPICH, HP MPI, SCALI
INTEL IA64	Linux		LAM/MPI, MPICH, HP MPI
INTEL Xeon EMT64	Linux	InfiniBand (Topspin, Voltaire), MyriCom, QLogic InfiniPath	LAM/MPI, MPICH, HP MPI, INTEL MPI, SCALI
NEC SX6	Super-UX		
SGI Mips	IRIX 6.5	NUMAlink	MPT
SGI IA64	SUSE 9 w/ProPack 4 RedHat 3 w/ProPack 3	NUMAlink, InfiniBand, (Voltaire)	MPT, Intel MPI, MPICH
SUN Sparc	5.8 and above		LAM/MPI
SUN Opteron	5.8 and above		

LS-DYNA Resource Page - Participant Software

Interfacing or Embedding LS-DYNA - Each software program can interface to all, or a very specific and limited segment of the other software program. The following list are software programs interfacing to or having the LS-DYNA solver embedded within their product. For complete information on the software products visit the corporate website.

ANSYS - ANSYS/LS-DYNA

ANSYS/LS-DYNA - Built upon the successful ANSYS interface, ANSYS/LS-DYNA is an integrated pre and postprocessor for the worlds most respected explicit dynamics solver, LS-DYNA. The combination makes it possible to solve combined explicit/implicit simulations in a very efficient manner, as well as perform extensive coupled simulations in Robust Design by using mature structural, thermal, electromagnetic and CFD technologies.

AI*Environment: A high end pre and post processor for LS-DYNA, AI*Environment is a powerful tool for advanced modeling of complex structures found in automotive, aerospace, electronic and medical fields. Solid, Shell, Beam, Fluid and Electromagnetic meshing and mesh editing tools are included under a single interface, making AI*Environement highly capable, yet easy to use for advanced modeling needs.

ETA — DYNAFORM

Includes a complete CAD interface capable of importing, modeling and analyzing, any die design. Available for PC, LINUX and UNIX, DYNAFORM couples affordable software with today's high-end, low-cost hardware for a complete and affordable metal forming solution.

ETA — VPG

Streamlined CAE software package provides an event-based simulation solution of nonlinear, dynamic problems. eta/VPG's single software package overcomes the limitations of existing CAE analysis methods. It is designed to analyze the behavior of mechanical and structural systems as simple as linkages, and as complex as full vehicles

MSC.Software - MSC.Dytran LS-DYNA

Tightly-integrated solution that combines MSC.Dytran's advanced fluid-structure interaction capabilities with LS-DYNA's high-performance structural DMP within a common simulation environment. Innovative explicit nonlinear technology enables extreme, short-duration dynamic events to be simulated for a variety of industrial and commercial applications on UNIX, Linux, and Windows platforms. Joint solution can also be used in conjunction with a full suite of Virtual Product Development tools via a flexible, cost-effective MSC.MasterKey License System.

MSC.Software - MSC.Nastran/SOL 700

The MSC.NastranTM Explicit Nonlinear product module (SOL 700) provides MSC.Nastran users the ability access the explicit nonlinear structural simulation capabilities of the MSC.Dytran LS-DYNA solver using the MSC.Nastran Bulk Data input format. This product module offers unprecedented capabilities to analyze a variety of problems involving short duration, highly dynamic events with severe geometric and material nonlinearities.

MSC.Nastran Explicit Nonlinear will allow users to work within one common modeling environment using the same Bulk Data interface. NVH, linear, and nonlinear models can be used for explicit applications such as crash, crush, and drop test simulations. This reduces the time required to build additional models for another analysis programs, lowers risk due to information transfer or translation issues, and eliminates the need for additional software training.

MSC.Software – Gateway for LS-DYNA

Gateway for LS-DYNA provides you with the ability to access basic LS-DYNA simulation capabilities in a fully integrated and generative way. Accessed via a specific Crash workbench on the GPS workspace, the application enhances CATIA V5 to allow finite element analysis models to be output to LS-DYNA and then results to be displayed back in CATIA. Gateway for LS-DYNA supports explicit nonlinear analysis such as crash, drop test, and rigid wall analysis.

Gateway products provide CATIA V5 users with the ability to directly interface with their existing corporate simulation resources, and exchange and archive associated simulation data.

Oasys software for LS-DYNA

Oasys software is custom-written for 100% compatibility with LS-DYNA. Oasys PRIMER offers model creation, editing and error removal, together with many specialist functions for rapid generation of error-free models. Oasys also offers post-processing software for in-depth analysis of results and automatic report generation.

EASi-CRASH DYNA

EASi-CRASH DYNA is the first fully integrated environment for crashworthiness and occupant safety simulations with LS-DYNA, and covers the complete CAE-process from model building and dataset preparation to result evaluation and design comparisons.

EASi-CRASH DYNA can be used for concept crash, FE crash and coupled rigid body/FE crash simulations in conjunction with MADYMO.

Full capability to handle IGES, CATIA V4, CATIA V5, UG and NASTRAN files

APTEK

The MMCD is a graphics-based and menu-driven program that interfaces with the LS-DYNA library of material models and the LS-OPT optimization code. The core of the MMCD is the driver, which calculates the stress-strain behavior of material models driven by combinations of strain increments and stress boundary conditions, i.e. pure shear stress, and combinations of uniaxial, biaxial, and triaxial compression and tension. MMCD input and output is accessed via pre- and post-processors; graphical user interfaces (GUIs) for easily selecting the material model parameters and load histories, and for plotting the output in both two (stress-strain curves) and three (yield surfaces) dimensions. The pre-processor, driver, and post-processor are combined into a web downloadable software package that operates seamlessly as a single code.

FEA Information Participants –
Company name takes you directly to Website

Oasys, Ltd: Markets engineering software products. Consulting engineers, planners and project managers working in all areas of the built environment.

JRI Solutions Limited: Specializing in Research & Consulting; System Consulting, Frontier Business, System Integration and Science Consulting.

Hewlett Packard: Personal computing, mobile computing, network management, 3-D graphics and information storage.

ANSYS, Inc.: Develops, markets, supports and delivers collaborative analysis optimization software tools.

SGI: Silicon Graphics, Inc., is a leader in high-performance computing, visualization, and storage.

MSC.Software: Information technology software and services provider.. Products & services used to enhance & automate the product design/manufacturing process.

Fujitsu Limited: Internet-focused information technology solutions.

AMD: Supplier of integrated circuits for the personal and networked computer and communications markets.

NEC Corporation A history of more than 100 years of leadership/innovation in the core high-technology sectors of communications, computers/electronic components

---

Intel: For more than three decades, Intel Corporation has developed technology enabling the computer and Internet revolution that has changed the world.

Engineering Technology Associates, Inc: Provides engineering & IT services & has

created the streamlined simulation software packages DYNAFORM and VPG

IBM: Invention, development & manufacture of advanced information technologies, including computer systems, software, storage systems & microelectronics

---

ESI Group: A software editor for the numerical simulation of prototype and manufacturing process engineering in applied mechanics.

Microsoft: For customers solving complex computational problems, Microsoft Windows Compute Cluster Server 2003 accelerates time-to-insight.

BETA CAE Systems S.A., Specialized in the development of state of the art CAE pre- and post-processing software systems.

LNXI - Linux Networx. Blending the price performance advantage of Linux clusters with real-world supercomputing expertise and innovation

---

Sun Microsystems Inc., provides network computing infrastructure solutions that include computer systems, software, storage, and services.

Detroit Engineered Products: a Michigan based engineering consulting and software products firm specializing in the area of Product Development products and solutions.

APTEK Among the software developed APTEK develops and licenses an interactive program for driving LS-DYNA material models - the Mixed Mode Constitutive Driver (MMCD).

PANASAS High performing Parallel Storage for scalable Linux clusters. Delivering exceptional scaling in capacity and performance for High Performance Computing (HPC) organizations.

Software Distributors

Alphabetical order by Country

Australia	[Leading Engineering Analysis Providers](#)
Canada	[Metal Forming Analysis Corporation](#)
China	[ANSYS China](#)
China	[Arup](#)
China	[MSC. Software – China](#)
Germany	[CAD-FEM](#)
Germany	[DynaMore](#)
India	[Oasys, Ltd.](#)
India	[Altair Engineering India](#)
India	[Cranes Software International Limited (CSIL),](#)
Italy	[EnginSoft Spa](#)
Japan	[Fujitsu Limited](#)
Japan	[The Japan Research Institute](#)
Japan	[ITOCHU Techno-Solutions Corporation](#)
Korea	[Korean Simulation Technologies](#)
Korea	[Theme Engineering](#)

Software Distributors (cont.)
Alphabetical order by Country

Netherlands	Infinite Simulations Systems B.V.
Russia	State Unitary Enterprise - STRELA
Sweden	Engineering Research AB
Taiwan	Flotrend Corporation
USA	Engineering Technology Associates, Inc.
USA	Dynamax
USA	Livermore Software Technology Corp.
USA	APTEK
UK	ARUP

International Consulting and Engineering Services

(continued on next page)

Alphabetical Order By Country

Australia Manly, NSW	[Leading Engineering Analysis Providers (LEAP)](#) Greg Horner info@leapaust.com.au 02 8966 7888
Canada Kingston, Ontario	[Metal Forming Analysis Corp.](#) Chris Galbraith galb@mfac.com (613) 547-5395
Germany Alzenau	[CARHS](#). 49 6023 96 40 60 [info@carhs.de](#)
India Bangalore	[Altair Engineering India](#) Nelson Dias info-in@altair.com 91 (0)80 2658-8540
Italy Firenze	[EnginSoft Spa](#) info@enginsoft.it 39 055 432010
UK Solihull, West Midlands	[ARUP](#) Brian Walker brian.walker@arup.com 44 (0) 121 213 3317

USA Consulting and Engineering Services

(continued)

USA Austin, TX	KBEC L.C Khanh Bui kdbui@sbcglobal.net (512) 363-2739
USA Windsor, CA	SE&CS Len Schwer len@schwer.net (707) 837-0559
USA Troy, MI	Engineering Technology Associates, Inc: (248) 729-3010
USA Corvallis, OR	Predictive Engineering George Laird (1-800) 345-4671 george.laird@predictiveengineering.com
USA Troy, MI	Detroit Engineered Products
ETA Troy, MI	Engineering Technology Associates, Inc. (248) 729-3010 sales@eta.com

Educational & Contributing Participants

Alphabetical Order By Country

China	Dr. Qing Zhou	Tsinghua University
India	Dr. Anindya Deb	Indian Institute of Science
Italy	Professor Gennaro Monacelli	Prode – Elasis & Univ. of Napoli, Frederico II
Russia	Dr. Alexey I. Borovkov	St. Petersburg State Tech. University
USA	Dr. Ted Belytschko	Northwestern University
USA	Dr. David Benson	University of California – San Diego
USA	Dr. Bhavin V. Mehta	Ohio University
USA	Dr. Taylan Altan	The Ohio State U – ERC/NSM
USA	Dr. Ala Tabiei	University of Cincinnati

Informational Websites

The LSTC LS-DYNA Support site: www.dynasupport.com

[LSTC/DYNAmore LS-DYNA Support Site](#)	[FEA Informationwebsites](#)
[LSTC/DYNAmore S-DYNA Examples](#) (more than 100 Examples)	[LS-DYNA Conference Site](#)
[TopCrunch](#) – Benchmarks	[LS-DYNA Publications](#) to Download On Line
[LS-DYNA Publications](#)	[LSTC_LS-PrePost Tutorials](#)
[CADFEM GmbH Portal](#)	

Assessing the safety of the embedding system of the guide rail of the Padova Metrobus

Marco Perillo[1], Mirko Facco[2]

[1]EnginSoft S.r.l
via Panciatichi, 40 Firenze

[2]EnginSoft S.r.l
via A. da Bassano, 1 Padova

info@enginsoft.it
www.enginsoft.net

Summary

The Metrobus is part of the recent public transport strategy of Padova. It is based on an innovative design developed by the Lohr Group, specialist in the design and creation of passenger and goods transport systems. The Metrobus is a new generation of light urban tramways, where the axle on pneumatic tyres replaces the railway boogie. The guiding of the bus is provided by a roller "V" system linked to a single guide rail which is level with the roadway, thus assuring accuracy of the route whilst avoiding wear and noise, avoiding also weighing on the rail, and mechanically impossible to derail. The uniqueness of the solution of Padova's Metrobus in connection with the common Lohr design, is the material which is used to embed the guide rail: a polyurethane resin matrix and inert black rubber composite.
This paper deals with the assessment of the safety of such embedded guide rail structure design, with respect to loads induced by the Metrobus itself and by the traffic as well as related to environmental conditions and ageing factors. The mechanical properties of the system are first determined by solving an identification-type reverse engineering problem on the available data coming from laboratory and in site tests. Then various FE analyses are carried out on highly non-linear models (ANSYS) including investigation on the dynamic answer of the system to impact forces from road traffic (LS-DYNA).

Keywords

Metrobus, Mooney-Rivlin, FEA, ANSYS, LS-DYNA, VPG.

1. Introduction

The Padova Metrobus is a new electric powered public passenger vehicle on tires expressly designed for operating on a dedicated rail line. Padova's Metrobus adopts an innovative automatic embedding system of guide rail using two couples of contrast wheels; the first couple is positioned in front of the axis wheel, the second couple behind it. This system imposes the axis wheel automatically on the rail path (Figure 1).
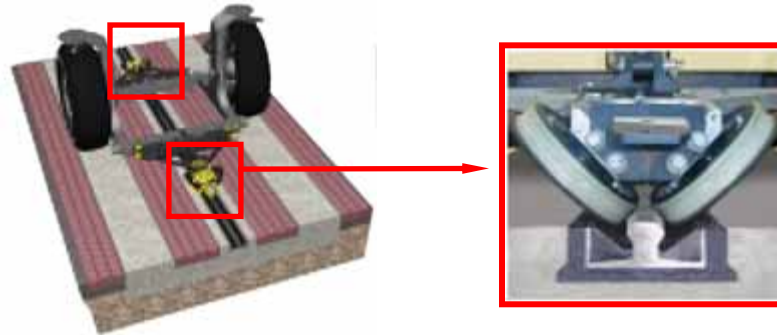

Figure 1 - Guiding system of Padova's Metrobus.

The rail is located in an u-shaped channel obtained from concrete slabs casted onto the road pavement. The concrete slabs form the base on which the Metrobus wheels run (Figure 2). The rail embedding in the channel is granted by a composite material compound set up (millimeter hard rubber parts in polyurethane resin matrix).
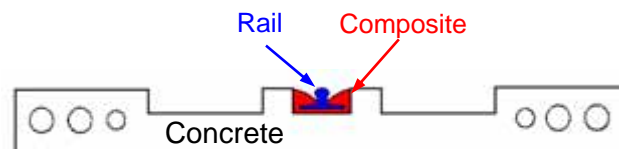

Figure 2 – Implantation system of the track to the groove.

This rather new set-up, has been successfully used in other similar light urban tramways. The uniqueness of the Padova system is the choice of material which was used to embed the rail into the channel: a polyurethane resin matrix and inert black rubber composite, named CONCRESIVE®.

The suggested choice of the designers (and the construction company) was to cut vibrations and noise. Moreover, it was particularly low-cost and easy and fast to carry out. The local authorities responsible for safety and layout solutions of rail-based systems, however, pointed out a number of objections and reservations. For instance, the lack of pre-existing experience or sufficient data on the reliability of the solution with respect to the ageing of the material. On the other hand though, the public was pushing for a fast solution to improve the transport system.

In this context, computational models were considered to examine various scenarios and to offer a forum to all parties involved, to document and discuss various solutions, and to reach the 'best' solution, with reliable safety margins.

Both engineering simplified models were used (beam on Winkler soil) and advanced fully 3/D FE models (ANSYS), as well as fast dynamic impact simulations (LS-DYNA).

2. Summary description of the work performed.

The objective of the study was to evaluate the coherence and safety of the system from an engineering point of view. In this light the following steps were carried out :

a) Identification of the composite material properties, using best curve fitting techniques based on experimental test results against reference FE models.
b) Setting up of simplified common engineering practice models, such as 'beam on Winkler soil' type models, to involve the size and the hierarchy of the problems, and to guide the choice of more advanced FE-based models.
c) Setting up of 2/D and 3/D models (ANSYS) with progressive refinement, to investigate the stress and deformation states with respect to the static-equivalent loading conditions.
d) Virtual proving ground simulations to evaluate the dynamic answer of the system to impulsive loads due to unordinary traffic situations, e.g. heavy truck tire passage on the rails.

3. CONCRESIVE® material data and material model characterization

The material model adopted for the resin is Mooney-Rivlin. Properties are determined by solving the identification problem stated on available data and reference FE models.

The main properties quoted by the producer of the resin are reported in the following table 1:

Concrete adhesion (UNI EN 1542)	> 1 MPa
Steel bars sliping resistance (RILEM-CEP-FIP RC6-78)	> 2 MPa
Hardness (ASTM D2240)	Shore A 50 (+-10)
Compression elastic module (EN ISO 604)	10 (+-5) MPa
Traction elastic module (DIN 53455)	5 (+-3) MPa
Traction resistance (DIN 53455)	> 1.5 MPa

Tab. 1 - CONCRESIVE® material properties

The identification problem was based on three series of test cases, referring to a vertical point load, a shear point load, and an axial load respectively, and by recording the entire load/displacement histories, up to the ultimate strength. Fully FE 3/D models were used on the simulation side (ANSYS 20-noded isoparametric elements with 14-points integration rule). The reverse-engineering-like identification problem was solved as if it were a direct optimization problem, using modeFRONTIER to drive the search. The difference between measured and computed data is negligible, as shown in table 2.

	DISPLACEMENT [mm]		
	Experimental	Numerical mod.	Error [%]
Axial Load test	7.42	7.175	3.30
Vertical Load test	1.27	1.275	-0.39
Lateral Load test	2.32	2.327	-0.30

Tab. 2 – Experimental vs numerical results.

4. Design loads.

The following design loads were taken into account:

Loads corresponding to normal and extreme working conditions.
Loads due to the crossing of traffic on the rail systems (both normal and exceptional, with reference to the planned route).

5. Results.

5.1 Analytical beam-on-Winkler soil approach

The beam of the Winkler soil reference model was based on a Winkler constant of 20 N/mm2 per unit length, roughly corresponding to a 20 Mpa Young's modulus of the resin. By solving the differential equations with the above values with respect to, for instance, a point load, one can obtain the maximum deflection as well as the wave length of deformation, respectively:

$$y_{max} = \frac{-W}{8 \cdot E \cdot I \cdot \beta^3} \quad \text{where} \quad \beta = \sqrt[4]{\frac{b_0 \cdot k_0}{4 \cdot E \cdot I}}$$

The latter is particularly useful to drive the choice of the portion of the system to be taken into account in the refined FE models. For instance, a vertical point load di 30000 N produces a max deflection of 1.4457 mm, and the wave length of 491.884 mm (having assumed a second moment of 1.47×106 mm^4 and a width of 150 mm for the rail)

5.2 2-D model approach

Various 2-D models were considered. The one shown in figure 1 was used to estimate the consistency of the analytical model mentioned above. The comparison suggests a Winkler constant of 19.47 N/mm^2 which is quite close to the one estimated in engineering data.
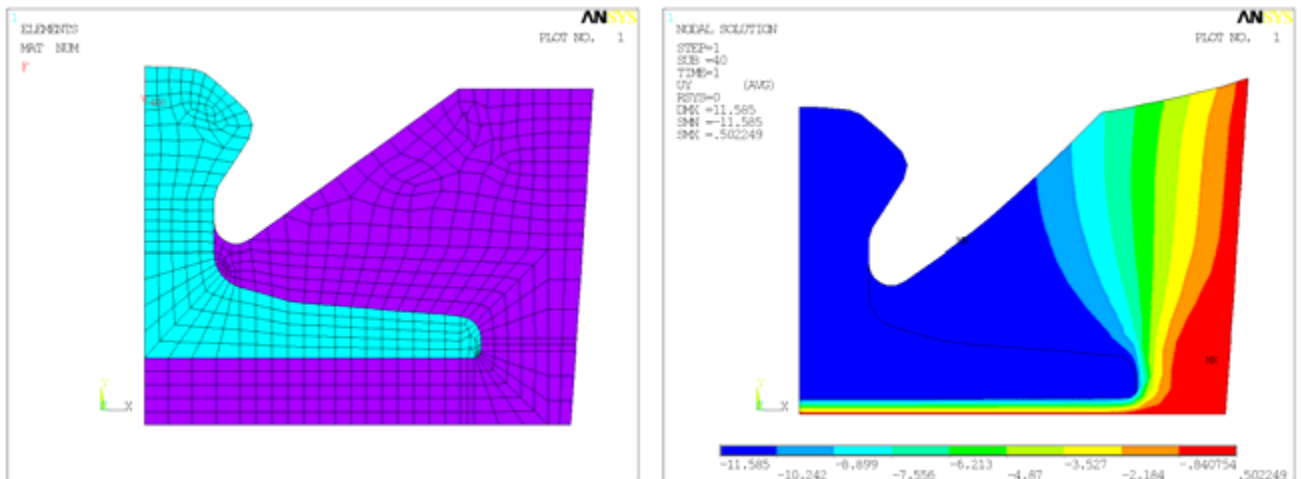

Figure 3 - 2-D static analysis: model and results

5.3 Fully 3-D model approach

Various fully 3-D models were used to investigate the static answer (or quasi static, that is including dynamic amplification factors as suggested by different standards) to different loading conditions.
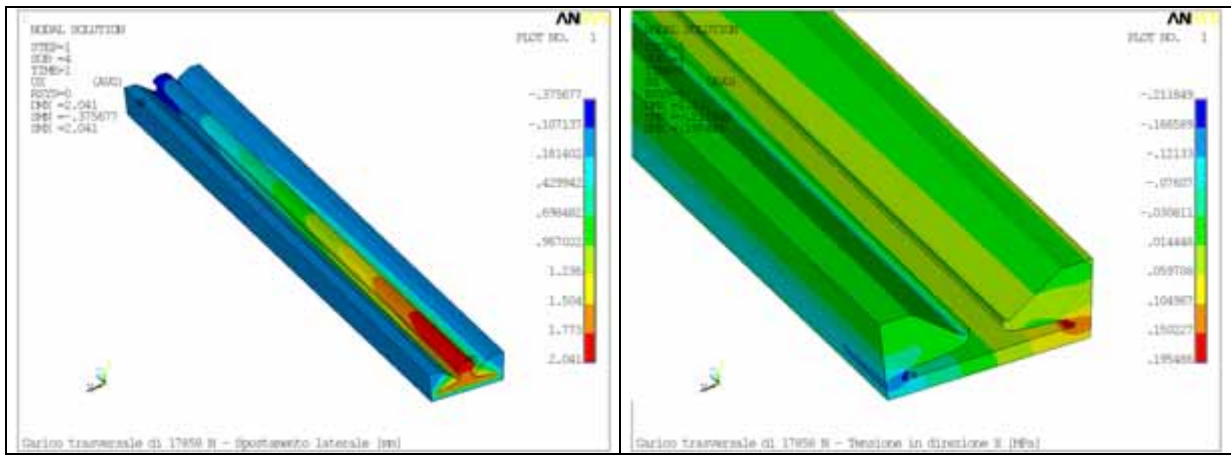
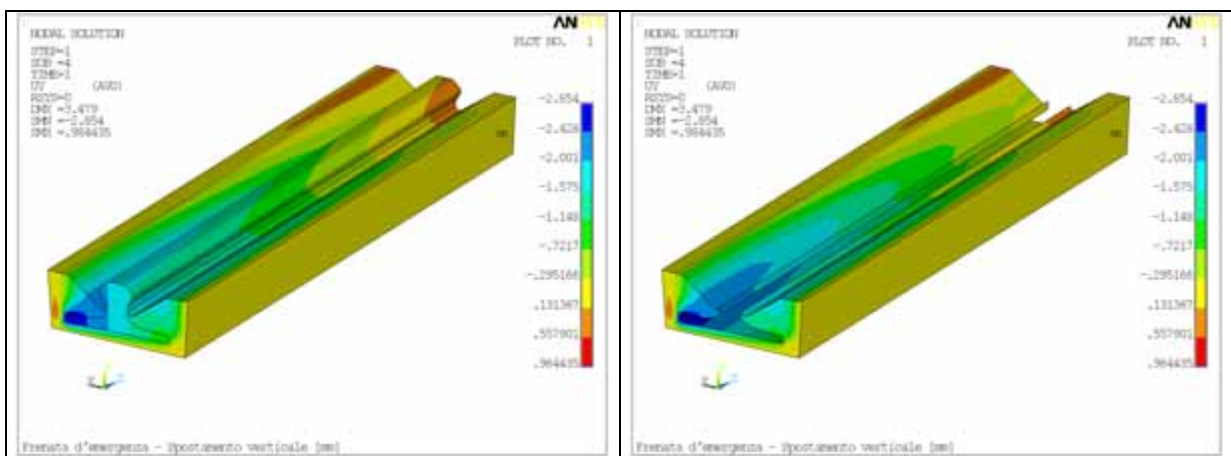Figure 4 – Lateral load case - Lateral displacement and directional stress

Figure 5 – Vertical load case – Vertical displacement and directional stress

Main obtained results are:
- Lateral load 17858 N
  - max vertical displacement   1.727 mm
  - stress (compression)   -0.212 MPa
  - stress (tensile)   0.195 MPa
- Vertical tensile load 30000 N
  - max vertical displacement   1.107 mm
  - stress   0.240 MPa
- Vertical compression load 44635.5 N
  - max vertical displacement   -2.771 mm
  - stress   -0.650 MPa
- Vertical load 51502.5 N + Lateral load 22072.5 N
  - min vertical displacement   -2.854 mm
  - max vertical displacement   2.83 mm
  - max compression principal stress   -0.726 MPa

5.4 Virtual proving ground (LS-DYNA) approach

Virtual proving ground simulations are performed to evaluate the dynamic answer of the system to impact loads, such as heavy truck tire passage on the rail. This approach was also used to discuss the reliability of the dynamic amplification factors used in the static-equivalent analyses described above.
VPG pre-processor code was used to translate and to import the LS-DYNA input file. VPG tools were used also to set up the FE model of the truck tire FEM model, to tune it and set up simulation conditions.
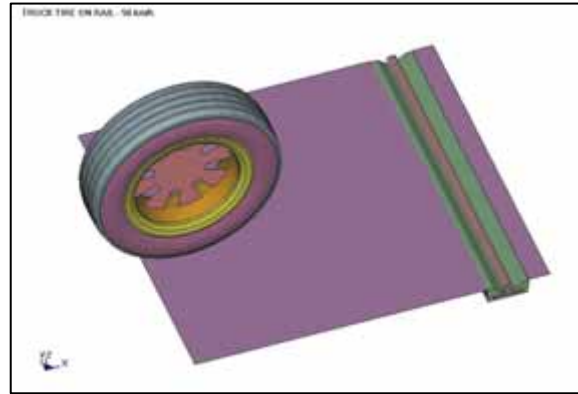
Figure 6 – VPG model for LS-DYNA simulation

Exceptional loads considered are related to heavy truck (19 tons) passage on the rail system. The axle load on single tire is 3750 kg.
Tire dimension, load and pressure data are:
Type: 254/80R20
Axle load x tire: 3750 Kg
Tire-road contact area 250*250 mm2
Inflating pressure: 8 atm
Velocity condition: uniform speed 50 Km/h

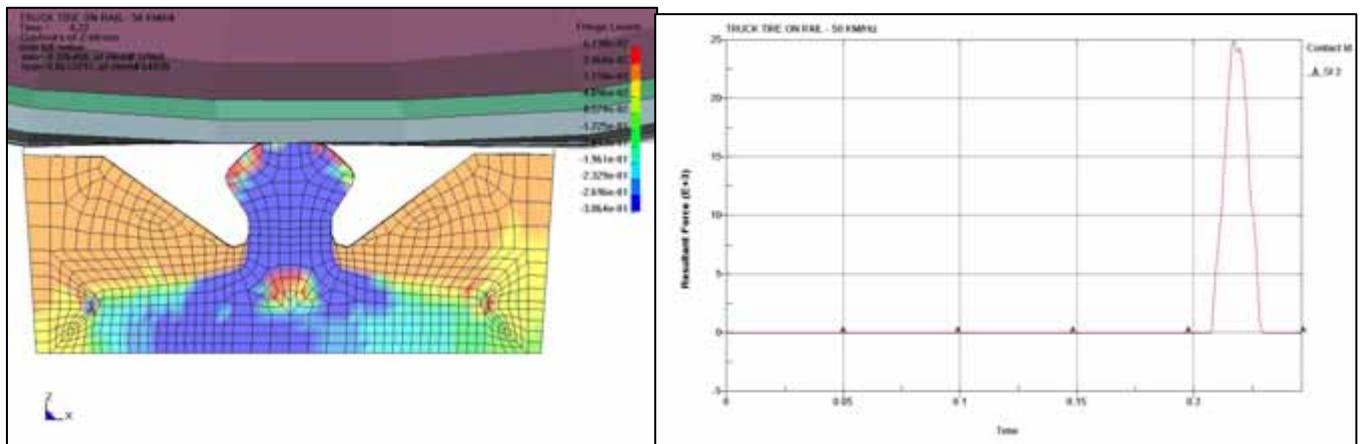Some results are shown in figure 7

Figure 7 – LS-DYNA simulations: Stress and tire-rail contact force

5.   Conclusions

Today, the Padova Metrobus has successfully completed its testing phase and is in service. Although the methods and procedures outlined in this paper are quite common in the FE community, the fact that public bodies and safety agencies based their decisions on numerical models makes this a unique case history.