New Train Design for Sleeper Comfort, Efficiency and Safety

新型列车设计-卧车 舒适性，效益和安全性

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Introduction 介绍

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Content /讲解内容

- **Zefiro family/ Zefiro系列**
- **ECO4**
- **Challenges/挑战**
  - **Comfort/舒适性**
  - **Efficiency/效益**
  - **Safety/安全性**

ZEFIRO Very High Speed trains/ *ZEFIRO*高速列车

The *ZEFIRO* products will cover a wide range of products:
ZEFIRO 产品范围：

ZEFIRO products
*ZEFIRO*产品

*ZEFIRO*250
- **Coaches/座车**
- **Sleeper/卧车**
- **8 car train/8车编组**
- **16 car train/16车编组**

Focus for this presentation

*V300ZEFIRO**
- **UIC coaches/座车**
- **8 car train/8车编组**
- **16 car train/16车编组**

***In cooperation with AnsaldoBreda for selected markets.**
在选定的市场上与AnsaldoBreda开展合作

*ZEFIRO*350+
- **Wide carbody Coaches**
- **宽车体座车**
- **8 car train/8车编组**
- **16 car train/16车编组**

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ECO4 – Energy Saving Solutions/节能方案

- ***ECO4*** is a suite of solutions, services, products and technologies, offering the best in class environmental performance, by providing future-oriented technology for the rail industry of the 21st century today.

  ECO4是一整套富有创新性的技术，服务和产品组合。节约能源、保护环境，这些产品及服务正在为21世纪运输装备的可持续性发展不断确立新的基准。

- ***ECO4*** is balancing the four “E”-cornerstones (Energy, Efficiency, Economy, Ecology) within convincing and reliable solutions, services and products.

  ECO4——建立于能源、效益、经济和生态四大基石之上——为用户提供可靠的产品技术和服务

- ***ECO4*** offers our customers added value to their trains and services and delivers on the promise of Total Train Performance.

  ECO4为用户带来产品和服务的增值，并不断提升列车综合性能。

Now, more than ever: The Climate is Right for Trains

现在，从气候，环保，节能角度看，发展轨道交通具有重要的意义。

Welcome to the World of eco4

ZEFIRO. Very high experience. Very high speed.

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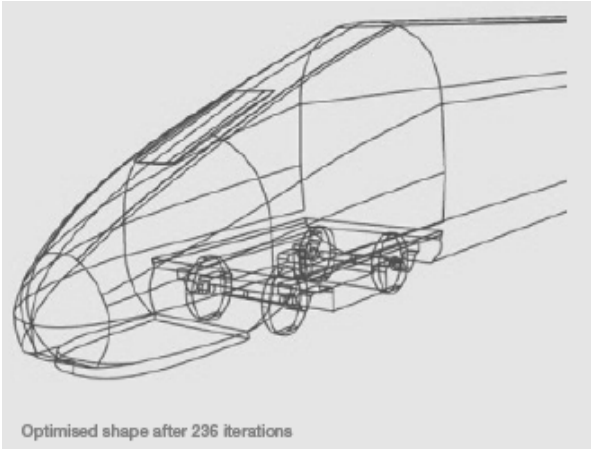
ECO4 technology in *ZEFIRO* Sleeper
ZEFIRO卧车的ECO4技术

AeroEfficient Optimized Train Shaping
符合空气动力学的列车外型

AeroEfficient is a new way of optimizing the complete configuration (e.g. head/tail, bogie, pantographs, equipment) for lowest wind resistance, cross wind stability, bow pressure wave and effects on noise.
根据空气动力效率，优化列车外型（如：车头/车尾，转向架，受电弓，其他设备等）以降低空气阻力，提高侧风稳定性，改善头波并降低噪音。


Optimised shape after 236 iterations

From a well proven 200 kph CRH1A train to a Sleeper train
从技术成熟的200 kph CRH1A项目到卧车项目

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Challenges in Sleeper design
卧车设计的挑战

§ Comfort 舒适性

– The requirement set for passengers is to provide low noise level such that you can enjoy an overnight trip.
卧车的设计应当为乘客提供低噪音环境，以使乘客享受到高品质的通宵旅行。

§ Efficiency 效益

– In addition to standard approaches in modern train such as Electro Dynamic braking maximization, this new Sleeper trains should provide advantages to the Operator:
除了采用了现代列车的一些标准节能措施，如最大化地利用电动制动力，新型卧车还具备以下优势：

- Energy efficiency with a new high speed nose (focus in this presentation)
新型节能高速车前鼻（本章节介绍重点）
- Commonality of parts/components for maintenance
零部件的可互换性，以方便维护
- Commonality for the driver's desk to reduce training
司控台设计的一致性，可简化司机培训

§ Safety安全性

– In addition to the inherent level of safety required for 250 km/hr operation, the design shall ensures the optimal fire safety protection for a Sleeper train
除了满足250 km/hr 速度列车固有的安全等级要求，卧车的设计还应当确保有最佳的防火安全保护。

CRH1A to CRH1E sleeper version/ CRH1A 到CRH1E 卧车 Main changes/主要更改项

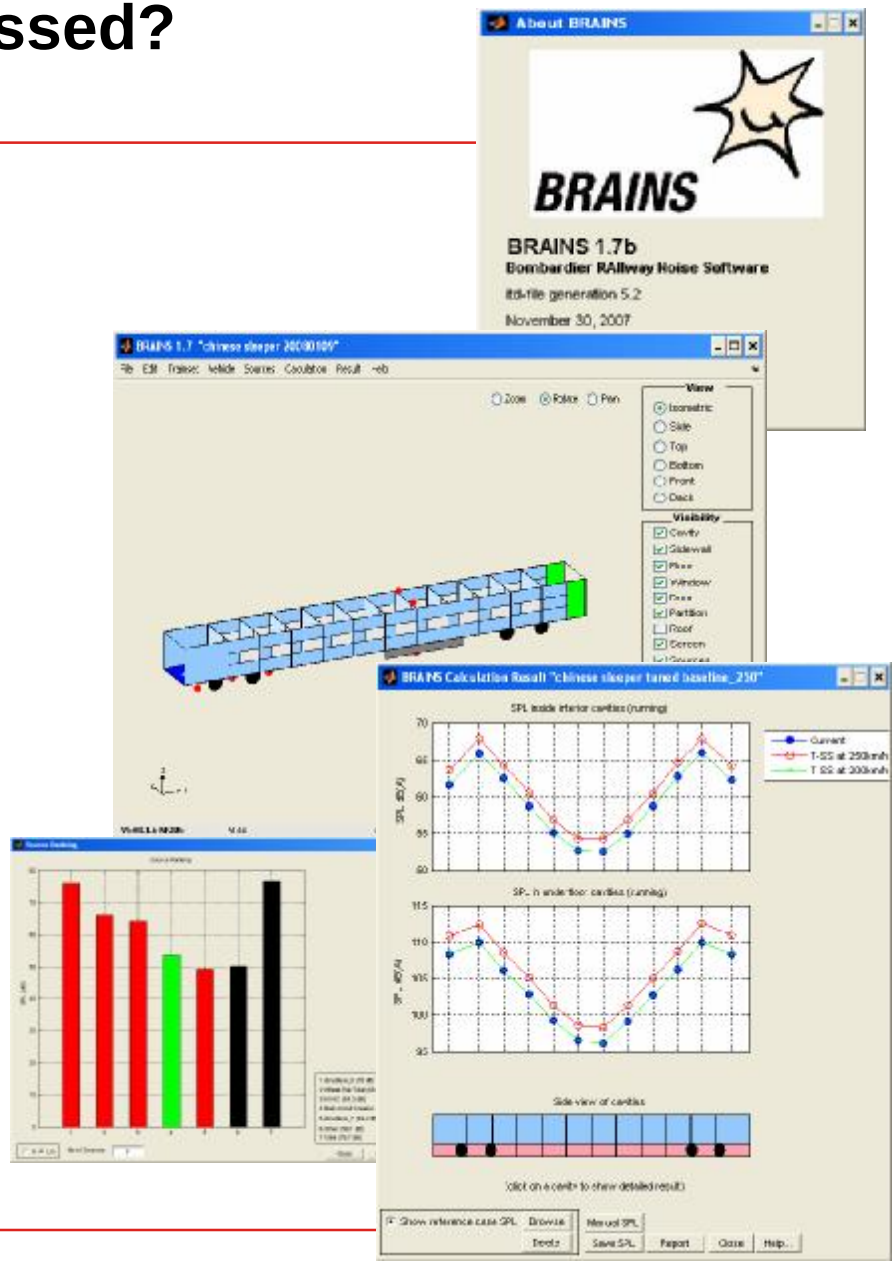
- **Vehicle level/列车级**
  - 250 km/h, 16-car configuration, Sleeper cars
    250 km/h, 16车编组, 卧车
- **Vehicle systems/车辆系统**
  - Center split gangway car 8 & 9, exterior door and steps, Pneumatic Line breaker, Kitchen increased capacity, Pantograph up to 250 km/h, On board Video entertainment system,…etc/第8车和第9车之间的对接式风挡，外车门和脚蹬，气动网侧断路器，厨房容量增加， 250 km/h速度受电弓，车载视频娱乐系统，等等
- **Vehicle interiors/车辆内装**
  - Sleeping modules, lounge area, crew compartments/包间模块，观光区，乘务员室
- **Electrical and control/电气和控制系统**
  - TCMS software modified, components re-arranged in cubicles and lockers/改进TCMS软件，重新布置电器柜中的电气部件
- **Exterior design/外部设计**
  - High speed nose/高速车前鼻
- **Bogie/转向架**
  - 250 km/hr operation
    适合250 km/hr 速度的转向架

Comfort/舒适度
Noise/噪音

- **Contractual requirements on noise/合同中对噪音的要求**
  - When running at 250 km/hr in open country, the noise level in the sleeper room shall not exceed the following level: 65 dB(A) in the sleeper room./在空旷地区以250 km/hr 速度行驶时，卧车包间内的噪音水平不应超过65 dB(A)
  - When sounding the warning horn, the following maximum level of 95 dB(A) in the drivers cab/鸣笛时，司机室内最大噪音水平为95 dB(A)
- **Improvements to reduce noise/为降低噪音进行的设计改进**
  - Main circuit breaker/主断路器
  - Floor/地板
  - Front design, horns and cab interior/车头设计，风笛和司机室内装
  - Sleeper module attachment to carbody/包间模块与车体的连接方式
  - HVAC
  - Propulsion equipment/牵引设备

How is the Performance Assessed?
如何进行性能评估？

- **Direct comparison with measured levels on CRH1 A vehicle (adjusted for higher speed operation)/直接与CRH1 A 车测得的结果进行比较（卧车运行速度有所提高）**
- **Bombardier in-house developed prediction tool for acoustics – BRAINS/ Bombardier公司自己开发的声学预测工具 BRAINS**
  - Exterior noise and interior noise calculated/计算外部噪音和内部噪音
  - A model of the vehicle is built up by acoustic cavities, panels, partitions and sources/计算用车辆模型包括声腔，墙板，间壁和声源
  - Noise measurements from CRH1A used to tune the model/使用CRH1A 的噪音测量数据对测试模型进行调整
  - Model updated with new data from suppliers when available/根据供货商提供的设备噪音数据及时更新模型



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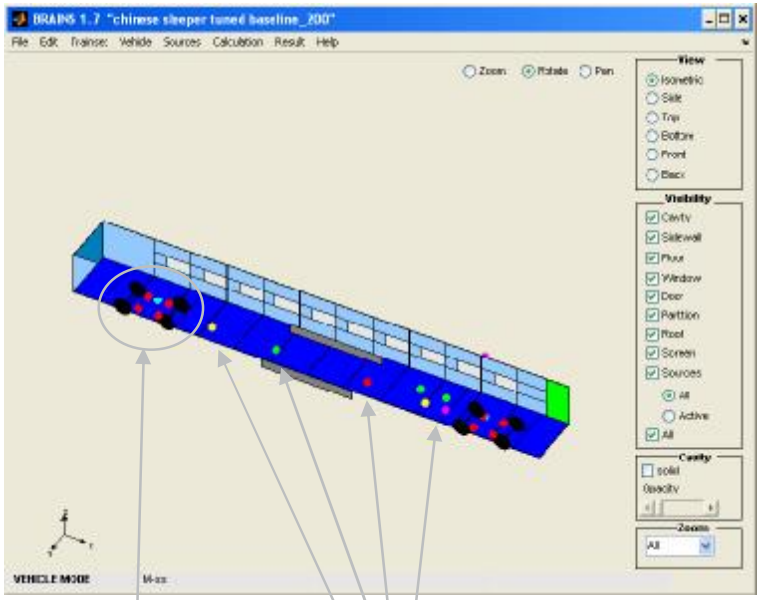
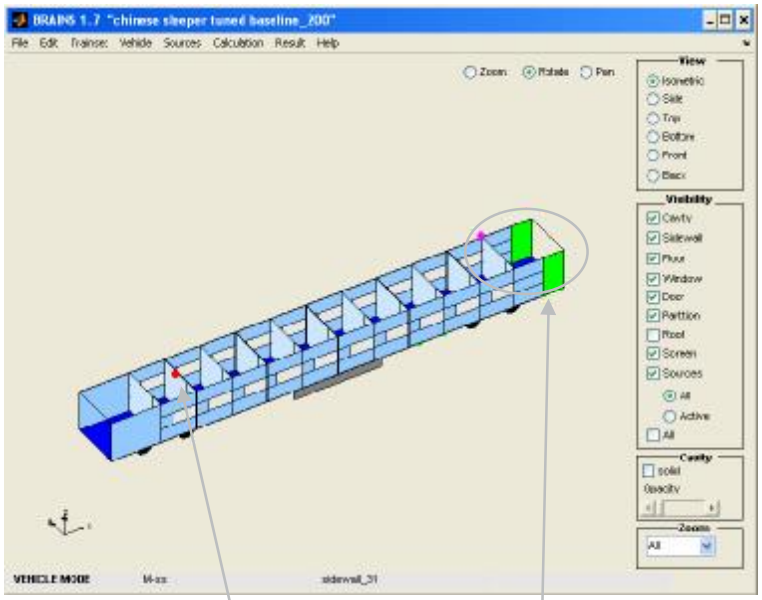
Noise predictions/噪音预测





Sources in underframe
底架内的噪音源

HVAC

Entrance area
外车门区域

Sources in bogie (Traction Motor +gear box)/转向架噪音源（牵引电机+齿轮箱）

§ Calculations show that 3 dB reduction compared to CRH1A design must be achieved to reach 65 dB(A) inside (particularly low frequency structure-borne noise need to be reduced)
计算结果表明为了满足车内噪音65 dB(A)的要求，卧车设计应当比 CRH1A提高3 dB的降噪水平 （尤其应当降低低频结构传递噪音 ）

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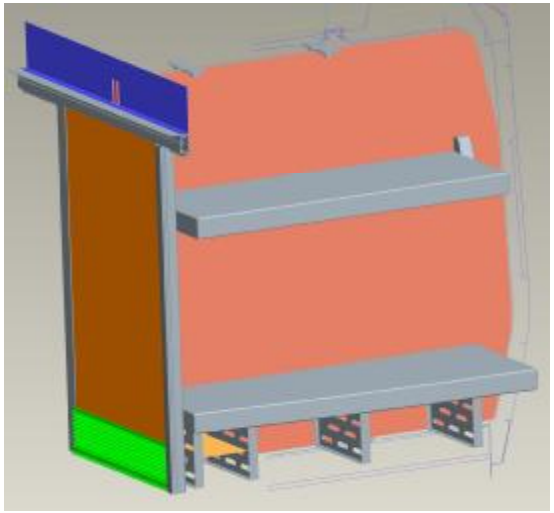
1st example/举例1
HVAC

- **Return air intake/回风口**
  - A 1 m long silencer integrated/整合了1m长的消音器
- **Transfer air between sleeper rooms and aisle/包间和走廊之间的空气传递**
  - A noise trap integrated at the air opening (green area) in the sleeper room to insure privacy/在包间气孔处（绿色区域）整合了一个降噪调节风门



2nd example/举例2
Front - Cab – Horns/车头-司机室-风笛

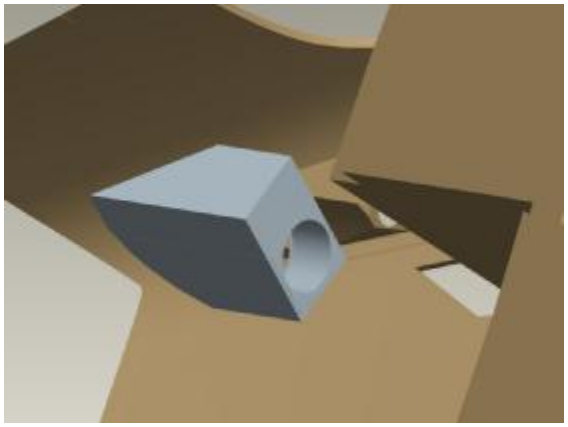
- **Main issue has been to ensure that there are no acoustic leaks into the driver's cab**

  司机室设计重要的一点是要保证噪音不能渗透到司机室内

- **Same floating floor proposed as in the sleeper cabins**
  采用与卧车车厢相同的悬浮式地板
- **Horn position (sealed box in front)**
  风笛的位置（车头罩内密封的风笛安装箱）
- **Outer surface as smooth as possible to avoid aero-acoustic noise (no protruding objects and cavities like handrails, HVAC, etc)**
  车外表面设计尽可能光滑，以避免产生空气噪音（没有突出的物体，没有把手之类的空腔，以及HVAC装置等）

Horns/风笛
2nd example/举例2

- **Sealed box to avoid noise leakage from horn into cab**
  密封的风笛安装箱可避免风笛噪音泄露到司机室内
- **Sufficient volume of box to ensure good function of horn**
  风笛箱有足够的容纳空间，以确保风笛的良好性能



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Efficiency/效益
High speed nose/高速车前鼻

New high speed nose developed specifically for the Zefiro 250 Sleeper.
这是专门为Zefiro 250 卧车项目设计开发的高速车前鼻端

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Efficiency/效益
High Speed nose/高速车前鼻

- **Aerodynamic calculations (CFD) are carried out to primarily assess the effects of the Nose and Tail. Results are used to calculate the total running resistance.**
  通过进行空气动力学计算（CFD计算）来对车头部和车尾部的空气动力学性能进行初步评估，并将计算结果用于总运行空气阻力的计算。

- **Improvement on the aerodynamic resistance due to new streamlined front-end of CRH-Sleeper is equivalent to the power of one traction motor on a 16 car trainset**

  (40 TM/train)
  通过改进CRH-卧车前鼻端，采用新的流线体设计，可明显降低空气动力阻力，节约相当于16车编组列车上一个牵引电机的功率（一列车上共有40个牵引电机）。

Fire Safety/防火安全

Fire safety measures are:/防火措施包括：

- **Combustible material fire property**
  易燃材料的防火性能
- **Fire alarm (focus in this presentation)**
  失火报警（本章节介绍重点）
- **Fire fighting equipment**
  灭火设备
- **Safety evacuation**
  安全疏散

Fire Detection/火灾探测
System tasks/系统任务

- **The train is equipped with a Fire Detection System, which detects smoke/heat in the driver's cab, crew cabin, toilettes, sleeping compartments and passenger areas.**

  列车装有一套火灾探测系统，可以探测司机室内，乘务员室内，卫生间，包间和客室内的烟火。

- **The purpose with the Fire Detection System will be in case of fire, to rapidly detect the smoke inside the train and thereby prevent spreading in other parts of the train.**

  火灾探测系统的目的是为了在发生火灾的情况下可迅速探测到列车内的烟火，以防止烟火蔓延到列车的其他部分。

- **It will also announces and turn on the light in the sleeping compartment where fire is detected, the purpose of this is to wake up sleeping passengers and alert the surrounding area.**

  在探测到包间内发生火灾后，会进行报警并打开包间内的灯，以叫醒乘客，并且会对火灾周边区域发出报警。

- **A fire will both generate smoke and heat which the combined heat/smoke detector is able to detect.**

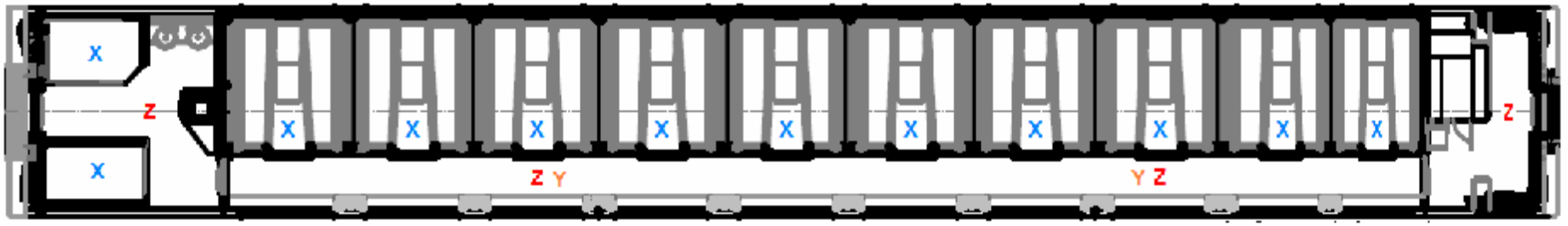
  联合式烟火探测器可以探测到火灾产生的烟雾和热源。

Soft sleepers cars/软卧车的火灾探测

Location/地点	Combined heat/smoke detector /联合式烟火探测器(X)	Aspirating smoke detectors/吸气式感烟探测器 (Z)	Audible alarm (80dB) /声音报警(Y)
Toilet/卫生间	2	-	-
Sleeping compartment/包间	10	-	-
Vestibule/Hallway /通过台	-	4	2

A-END/A端

B-END/B端



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Key advantages of the *ZEFIRO* Sleeper/
*ZEFIRO*卧车主要优点

- Designed for highest operational speed (250 km/hr).
  设计最高运行速度250 km/hr
- Provides a comfortable, efficient and safe operation.
  可提供舒适，节能和安全的运行服务
- Futuristic Design Concept beneficial of Bombardier knowledge and expertise in aerodynamics
  得益于Bombardier公司在空气动力学领域的专业知识， *ZEFIRO*卧车具有现代化的设计概念
- Ecological – incorporates Bombardier's ECO^4 feature
  *ZEFIRO*卧车项目将社会生态学结合到Bombardier公司的ECO^4 理念中。


Thank you for your attention !