

INSTITUTION OF MECHANICAL ENGINEERS HONG KONG BRANCH
TECHNICAL VISIT TO BYD SHENZHEN ON 22/5/2018



IMechE-HKB technical visit to BYD Shenzhen on 22/5/2018

From humble beginnings as a market town of 30,000 people in 1979, Shenzhen and its metropolitan area has seen an extraordinary scale of growth in less than 40 years to an urban conurbation of over 23 million. In parallel with this has been the growth of new technology industries in the region one of whom is the now internationally known BYD. The company was started two decades ago by its visionary entrepreneurial founder in a small rented factory manufacturing rechargeable batteries. Today BYD has established itself to become a multi-billion dollar technology giant as well as becoming a globally recognisable brand. The company is a leading automotive manufacturer in China and it has its own state-of-the-art research and development (R&D) facilities for vehicles based within its Shenzhen manufacturing facility. Institution of Mechanical Engineers Hong Kong Branch (IMechE-HKB) was recently privileged to be invited to visit the BYD automotive facilities on 22/5/2018 and to appreciate how automotive engineering has developed just across the border of Hong Kong.

An Electric Start

BYD started as a manufacturer of nickel-cadmium (NiCd) batteries in Shenzhen, mainland China in 1995. Before this time NiCd batteries were the primary commercial rechargeable battery model and the Japanese dominated the global supply of these. The year of BYD starting the Japanese government imposed a restriction on exporting NiCd batteries which resulted in the acute shortage which needed to be

filled. BYD were well placed to seize this opportunity and started supplying batteries from Shenzhen.

Today BYD is a multi-business enterprise publicly listed in both Hong Kong and Shenzhen encompassing businesses providing consumer electronic products, batteries, automotive, solar energy and lighting. Employing 230,000 people globally, BYD has five (5) in-house research institutes, namely (i) Central Research Institute, (ii) Auto Engineering Research Institute, (iii) Electric Power Research Institute, (iv) Truck and Special Vehicle Research Institute and (v) Light Rail Transit Research Institute.

Supported by Central Research Institute, BYD offers design and production solutions for many major consumer electronic product brands. It is a major original equipment and design manufacturer for companies like Apple, Huawei and Samsung, supplying them plastic components, surface finishing, batteries, electronic systems and the like. Furthermore BYD is gaining ground in the renewable energy sector where it's Shanghai division designs and manufactures photovoltaic (PV) panels with a capacity factor up to 18.5 %, while the uninterruptible power supply products are powered by BYD's own lithium iron phosphate batteries. In parallel, BYD develops light emitting diode (LED) lighting devices and its PV panel-coupled LED street-lights are used to illuminate BYD Road outside the BYD headquarters in the Ping Shan District of Shenzhen.

BYD Assembly Research & Development

BYD designs and manufactures passenger cars, buses, coaches and trucks. Passenger cars range from the conventional internal combustion engine (ICE) model to petro-electric hybrid or ultimately pure battery electric. Meanwhile the buses, coaches and trucks are exclusively pure battery electric. BYD non-ICE passenger cars can be remotely and driver-less driven by a key-holder-sized, "Bluetooth" based controller. The maximum speed in the remote control mode is limited to 3 km/h and the maximum range is 20 m. Braking intervenes automatically once the hand is off the controller to avoid coasting.

The BYD factory at Ping Shan in Shenzhen is not only the BYD corporate headquarters, it is also where the final assembly lines for passenger cars and the automotive R&D laboratories are located. At the time of IMechE-HKB visit, the vehicle models M6 and e6 were under final assembly on the same international standard production line with continuously moving tracks and assembly fixtures for to facilitate rapid fitment of all major components. Equipped with seven (7) seats the M6 is reportedly an extremely popular model which has sold 120,000 units in April 2018.

The RMB100 million-worth R&D laboratories include an integrated Auto Safety Laboratory, Electro-Magnetic Capability (EMC) Laboratory and Noise, Vibration Harshness (NVH) Laboratory amongst others. They are all state-accredited automotive laboratories which can conduct tests to the Chinese national standard (i.e. *Guo Biao* or GB), as well as being qualified to conduct testing for European Union directives, Economic Commission for Europe (ECE) Regulations and Federal Motor Vehicle Safety Standards (FMVSS) for the North American market.

The Auto Safety Laboratory houses Vehicle Crash Laboratory (VCL). Inside the VCL, the Front Crash Hall offers crash tests of vehicles against various barriers at different angles at the maximum speed of 120 km/h from 250m distance. In the Middle Crash Hall, the crashing of cars from 0°, 15°, 30°, 45°, 60°, 75° and 90° at the maximum speed of 60 km/h can be conducted. Rollover test rigs are also in place to perform static roll-over of vehicles in testing no leakage of fuel and battery fluid upon roll-over accidents.

Due to its large indoor volume, the entire indoor area of VCL is not air-conditioned. In fulfilling the requirement that the test specimens are to be at certain temperature upon the test, they are temperature-regulated by a mobile conditioning room. Its interior volume is sufficient to house the entire vehicle and is mobilised to cover and pre-condition the tested specimens at their stationary position before conducting the crash test.

Each VCL-conducted destructive test is reported to cost RMB300,000, which excludes the vehicle cost of about RMB100,000.



Mr. Walter Kung, the organiser of the technical visit, presents the certificate of appreciation to the representative of BYD on behalf of IMechE-HKB

When it is only required to test passenger saloon devices, such as seats and position restrainers, these are tested under crash condition simulated by a High-G Sled. The High-G Sled is accelerated by pneumatic force and halted at high velocity, modelling the rapid decelerations experienced within a vehicle during a crash at speed. The test specimens are mounted directly on the High-G Sled for dynamic testing.

BYD vehicles are also tested statically. Inside the EMC Laboratory, which is the largest in China and has cost RMB 64 million to build, driving is simulated with the assistance of a full chassis dynamometer. The vehicle's electro-magnetic behaviour with regard to both immunity and radiation is then measured in detail. The EMC test cell walls are fully covered in anechoic material to prevent wave reflection, is air-conditioned and spacious enough to accommodate an 18 m long bus or coach for the testing.

Another semi-anechoic chamber and also the largest in the country is the NVH Laboratory where testing of noise, vibration and resonance levels of a vehicle are carried out. The surface profile of the chassis dynamometer inside NVH Laboratory can be changed to simulate different road conditions and as such the noise the vehicle generates in motion. Similar to the EMC

Laboratory, the NVH Laboratory is fully sized to perform NVH tests on a large commercial vehicles.

Summary

Across the border of Hong Kong, Shenzhen is a vibrant city for new technologies and services. The automotive engineering sector is led by BYD which not only produces vehicles but specialises and excels in the design and manufacturing of electric and electronic-related components as well as complete products. The vehicle assembly lines and R&D are located in the north eastern part of the municipality. The IMechE-HKB members were very impressed by the advanced automotive R&D establishments which shows the advance of the auto industry in PRC that has taken place over the past couple of decades and it's close proximity to Hong Kong.

IMechE-HKB thanks BYD for its hospitality in offering its members the technical visit on 22/5/2018.

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IMechE Hong Kong Branch
Activity Sub-Committee – Technical Visit Group

TECHNICAL VISIT to BYD Shenzhen Plant 2018

BYD Company is the largest Pure Electric Vehicle (EV) manufacturer in China. This visit is mainly to understand the development and manufacture process of the BYD vehicles in the BYD Shenzhen Plant.

Date: May 22, 2018 (Tuesday)
Time: 8:00 – 18:00

The schedule of the visit is shown below:

08:00 - 08:15	Gather in Futian Checkpoint Station 福田口岸
08:30 - 09:50	Take bus to BYD Shenzhen
10:00 - 10:30	Briefing session and Introduction of BYD Company
10:30 - 11:00	Q & A Session, Group Photo Taking and Present Souvenir
11:00 - 11:30	Visit to BYD Museum
11:30 - 12:30	Visit to BYD Charging Station
12:30 - 13:50	Lunch Time
14:00 - 15:00	Visit to Car Protection Line
15:15 - 16:15	Visit to BYD Laboratories
16:30 - 17:50	Take bus to Futian Checkpoint Station 福田口岸

HKD \$150 for lunch

Number of participants is limited to 36
Priority given to IMechE members

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