RCEA
(SUSSEX)

An Association for Retired Professional Engineers

NEWSLETTER December 2017

President's Message

Welcome to the December Newsletter.

We have recently welcomed several new members to the Association. This is encouraging, as we need new 'blood' to ensure that the RCEA has a long term future and hope that these new members will get fully involved in the Association's activities. Please encourage any of your contacts with an interest in engineering matters to consider joining us either as a full or associate member.

We have recently launched a Facebook Group (Club) named RCEA (Sussex). As many of you will be aware we have e- mailed information to members on how to join. We hope that members will make use of this ability to exchange information. It is early days and it will be interesting to see how many members sign up to the group.

I wish you all and your families a Merry Christmas and a Happy New Year.

Derek Webb

December 2017

PROGRAMME OF EVENTS December 2017 – May 2018

12th Dec	**Tuesday**	**Talk – "Operation Chastise, No 617 Squadron, The Dambusters"**
21st Dec	**Thursday**	**Coffee - at Spotted Cow, Angmering**
28th Dec	**Thursday**	**Coffee - with Partners at Swallow's Return**
9th Jan	**Tuesday**	**Talk "Steel – from Bessemer to today"**
18th Jan	**Thursday**	**Coffee - at Spotted Cow, Angmering**
25th Jan	**Thursday**	**Coffee - with Partners at Swallow's Return**
13th Feb	**Tuesday**	**Talk – "Bring Energy to Life – Electricity system operator "**
15th Feb	**Thursday**	**Coffee - at Spotted Cow, Angmering**
22nd Feb	**Thursday**	**Coffee - with Partners at Swallow's Return**
13th Mar	**Tuesday**	**Talk – "Across India by train"**
16th Mar	**Thursday**	**Coffee - at Spotted Cow, Angmering**
29th Mar	**Thursday**	**Coffee - with Partners at Swallow's Return**
18th Apr	**Wednesday**	**Spring Lunch – Northbrook College**
19th Apr	**Thursday**	**Coffee - at Spotted Cow, Angmering**
26th Apr	**Thursday**	**Coffee - with Partners at Swallow's Return**
3rd May	**Thursday**	**Visit - Ford Research and Development Centre - Dunton, Essex**

All Talks and Meetings will commence at 2.30 pm and be held in the Chichester Room, Field Place, Worthing unless another venue or time is indicated.
Timings for visits and outings will be as printed in the detailed description of the activity.
Coffee mornings commence at 10.30 am.

We apologise for only being able to publish a short list of our forthcoming events. This is simply due to the difficulties we now face in booking speakers and visits far ahead. As you know we sometimes have to cancel/rearrange talks and visits, often at short notice. We suggest that members should increasingly rely upon our website for up to date details of events.

Membership Subscriptions 2017/2018

Our thanks go to all members who have renewed their subscriptions. Those members not renewing should note that their membership will cease on 1/1/2018.

Website of the RCEA

Our website, **www.rceasussex.org.uk** carries the very latest information on all of our events.

New Members and Speakers for Talks

The RCEA needs new members and speakers to ensure that we can continue as a thriving organisation. Please think of appropriate people you know and encourage them to come along to our talks and hopefully join the RCEA.
We also need more speakers to give talks to us on Tuesday afternoons from September to March. We are aware that many members have the knowledge from their working careers to provide interesting talks. If you are willing to give a talk please let us know. Speakers from outside organisations are increasingly harder to find and often seek payment for their services.

New Members

R T F Clark, B Sc, C Eng, MICE

C. Coates, C.Eng, MIFireE, BSc

A.E.Connorton, M Sc (Energy), B Sc (Hons), B Sc (Eng), C Eng, FIMechE

D. Kershaw, C Eng, MIMechE, BSc

C. P. Sherwin, MIEE, BSc(Eng)

A. G. Varney, C.Eng, MIET

Latest Member's Handbook

Would all members please check their entry in the Members Handbook which has just been issued to ensure that their entry is correct in every detail i.e. address, telephone number, e-mail address, etc.
Similarly if members become aware that a fellow member no longer lives at the address that we publish in the handbook, we would be grateful for the information. Any errors or omissions should be communicated to **Mike Wooldridge, Membership Secretary** so that the appropriate corrections can be made to the master copy ready for printing the next Members Handbook.

RCEA Insurance

Members need to be aware that the insurance policy that the Association holds is solely for the protection for the assets and liabilities for the Association as an entity. The policy does not provide cover for personal injury or loss to individual members. Members attend the Association's events at their own risk; although under some circumstances there may be some cover from the insurance arrangements of the venue owner.

Newsletter Entries

If you would like to provide an article for inclusion in a future newsletter it would be very welcome as we are always looking for new material in addition to reports on previous talks and visits/outings. From feedback from our members we know that the newsletter is particularly appreciated by those who are no longer able to get to our meetings and visits, so if you are able to contribute in this way it would be much appreciated. Articles should preferably be Microsoft Word documents, although we can usually convert both text and pictures (even photographs) into a suitable format. Accompanying pictures are best supplied as separate files which will be embedded within the text during editing.

Brief Detail – Talks, Outings and other activities January – April 2018

Talk.
Tuesday 9th January - Steel – from Bessemer to today

Dr Tim Smith, Consulting Editor, Steel and Aluminium

In 2016, 1.62 billion tonnes of steel were made worldwide of which half was made in China.
Quality of product and efficiency in production has rapidly improved there largely thanks to the adoption of western supplied technologies.
Nearly three-quarters (74.2%) of steel today is made in the basic oxygen converter (BOC), the remainder mainly in electric arc furnaces. The BOC is an evolution of the Bessemer process introduced in 1856. In the BOC, pure oxygen is blown into molten blast furnace iron at supersonic speed to reduce the carbon content from 4.3% to near zero. The same principle was applied by Bessemer but he did not have tonnage oxygen or supersonic lances so blew air through the base of the vessel which caused porosity in the steel because of its high nitrogen content. With help and perseverance, this, and other problems, were overcome.
The talk will follow the development of steelmaking into the 21st century.

Talk.
Tuesday 13th February – Bring Energy to Life – Electricity system operator

Tianyu Luo - National Grid

As Great Britain's electricity system operator, National Grid takes the responsibility to plan and operate the electricity system to comply with the Security and Quality of Supply Standard. The presentation introduces the National Grid's roles in the Great Britain's electricity market and daily electricity system operational actions including energy balancing, managing uncertainty, demand forecasting, and system constraints. An update of future electricity network and relevant ongoing projects will be discussed followed by the Q&A section at the end.

Talk.
Tuesday 13th March – Across India by train

Colin Boocock

Colin and his wife spent two weeks travelling by train across northern India from Shimla in the Himalayan foothills to Delhi, Agra and the Darjeeling Himalayan Railway. They finished up with a tram ride through old Kolkata (formerly Calcutta). This talk mixes diverse railway interest and spectacular scenery with insights into the teeming cities, architectural treasures, the people and even visits to organisations that help destitute children. Be surprised at the modern India!

Spring Lunch
Wednesday 18th April 2018, Northbrook College, Worthing, 12.00 for 12.30

This occasion is not only an opportunity for new and existing members to meet socially, but also provides 'work experience' to chefs and waiters studying at the college.
There will be a bar for pre-lunch drinks, the cost to be settled individually by members and guests. The cost of the three course meal is £15 per head including a tip, which in the past has proved to be very good value. Applications should be made by 1st April 2018.
Should the numbers exceed the maximum seating allowed there will be a waiting list, as in previous years, so please book early to avoid disappointment. The committee look forward to seeing you there.
Booking form is at the end of this newsletter.
Contact George Woollard - 01903 523640, e-mail Georgewoollard1@hotmail.co.uk

Visit.
Thursday 3rd May 2018 – Ford Research and Development Centre - Dunton, Essex.

We have been able to arrange a return visit to Dunton where we will be able to view the equipment and techniques used to ensure that Ford cars of the future meet specific worldwide regulations, performance and durability targets, marketing and customer requirements etc. The equipment includes many **engine and emission dynamometers (at least one with atmospheric control)**, environmental wind tunnel, **test tracks**, styling studios, machine shops, **many durability rigs for body and chassis components** etc. Exactly what we will be shown will depend on the confidentiality of the vehicles being tested but I have requested the areas highlighted above. Cameras will not be permitted. Only 15 places are available, so we will have to award places and reserves according to the time we receive the reply slips. RCEA members will have priority over guests. Unfortunately travel time will be longer than normal visits (approximately 100 miles via the M25) and attendees will be responsible for their own travel arrangements. Members may wish to car share. The tour starts at 13:15pm. There are a few eating places within easy reach of Dunton and suggest that we meet at around 12 o'clock at one of them (to be selected nearer the time). The booking form is at the end of this newsletter.
Contact Ivan Farrow 07971184207, e-mail ivan_farrow@yahoo.com.

Reports

Talk
Tuesday 19th September 2017 'Working on the Construction of Britain's Motorways 1960-1990'
Frank Duggan RCEA

The foundations of British roads were created in the Roman era. For the next 1500 years coastal shipping, canals and railways were used to transport people and goods. Subsequently, the first road built to Motorway standards in Britain was the Preston-by- Pass, completed in 1958.

From 1958 to 1990, 2000 miles of Motorways were constructed. This compares to the 2000 miles of roads built by the Romans, and the 14,590 miles of Railways built during the years 1825 and 1852.

The demolition and re-construction the new London Bridge (1968-1972) over the Thames was one of the first major bridges built in the 20th century Motorway era.

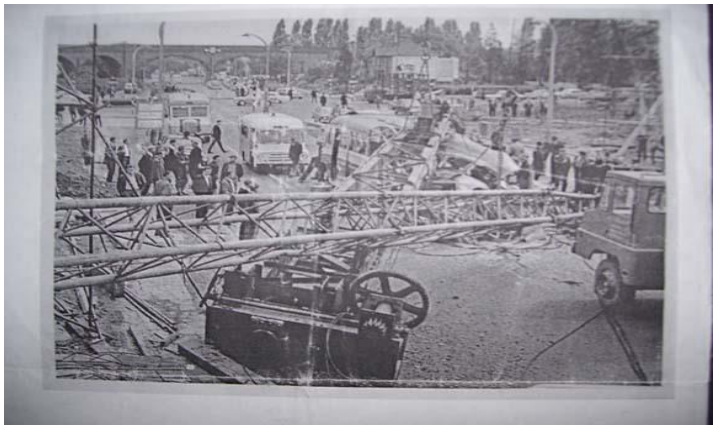
In the 1960's temporary re-erectable flyovers were thought to be the solution to traffic congestion. These were designed to solve bottlenecks at cross roads and were erected in Bristol, and on the M40 in West London. Planners expected them to have a number of re-uses. Instead they became an indispensable part of the road system and remained in place for around 30 years.

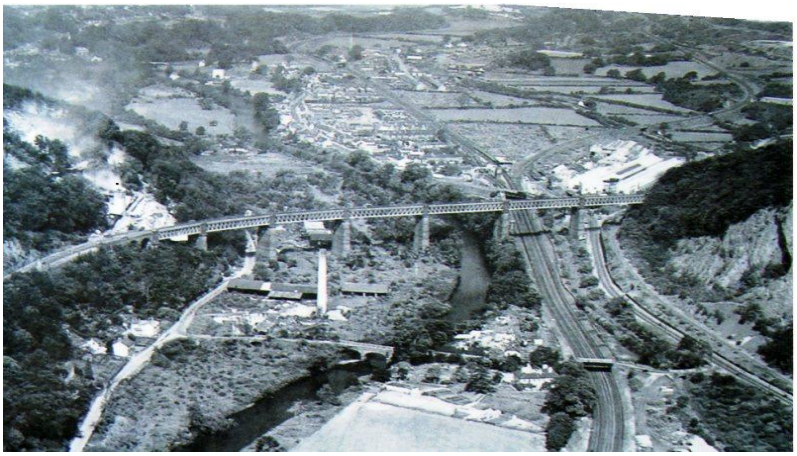
Computers programmes were developed in the 1960's. They had an immediate effect, and facilitated the development of procedures that revolutionised the design of road alignments.

The construction of Brent Cross Flyover (1966-1968) over the North Circular Road in North London was also an early structure.

This was built to remove a bottleneck on the North to South, and East to West, flow of traffic, into and out of London.

The contract was hit by tragedy as shown opposite. In 1964 the jib of a mobile crane erecting a derrick collapsed onto a moving coach. 7 died and many more were injured.





In the early 1970's it became Government policy to move businesses from City Centres, ease congestion in tourist areas and improve infrastructure between cities in the South East. These plans involved the construction of the A30 Exeter bypass, the M11 London to Cambridge Motorway and the A470 Cardiff to Merthyr Road shown opposite.

By 1982 most of the M25 had been completed, and the final sections got underway. Completion made the M25 for a time the longest City bypass in the world. The M25/M40 interchange shown opposite was completed in 1985. This contract employed the first reinforced earth retaining wall, and, by designing the M25 to pass through one of the arches of the Chalfont Railway viaduct which had been built around a century earlier showed how engineers could collaborate over the centuries.

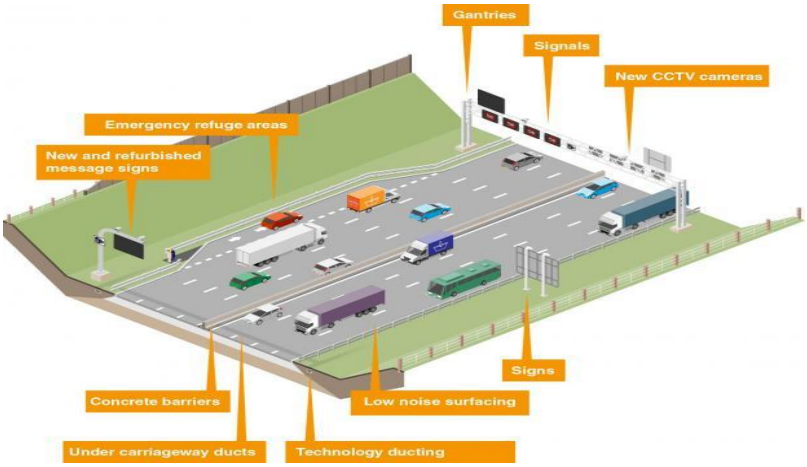
The Chapel-en-le- Firth bypass in the Peak District was one of the most difficult road contracts undertaken in the UK. Cost escalated from £18m at tender, to £45m on completion. The extra cost was due to difficult geological conditions, and in overcoming engineering problems brought about from building through extensive fill deposits. These had been laid down when the area was a centre of lime and quarrying activities.

The Motorway era experienced a number of tragic accidents.

Some were as a result of temporary works failures, others as a result of design failures. The collapse of the supports for Loddon Bridge (1972) during construction, and the design failure of the Cleddau Bridge(1970) in Milford Haven shown opposite are two examples.

Both incidents had a profound effect on the industry.

Today we are in a period of 'Smart Motorways'. Technology is being used to reduce congestion, improve journey times, and make a more comfortable driving experience. The M42 shown opposite is a good example.



New infrastructure has also benefited from the advance of technology. The recently opened Queensferry cable-stayed bridge has 2000 sensors embedded into the structure and these produce 8Gb of data daily.

Roads are now being successfully used to provide energy from photovoltaic tiles built in to the surface. In France the energy this provides is being supplied to the national grid. In Alberta, Canada this technique is also being employed.

The Highways Agency in Britain is considering covering motorways with cantilever canopies to reduce pollution, and building double decker roads as a means of reducing the environmental impact on land and to increase road capacity.

The future use of our roads will be dictated by the rapid developments in technology. Mass production of vehicles and the building of motorways provided work for thousands, and the wide availability of road transport and motorways provided undreamed mobility for millions.

Visit
Wednesday 27th September 2017 - Ford Dunton Technical Centre

We visited Dunton just a few days before the golden anniversary of the official opening by Harold Wilson on12th of October1967.

Dunton was then, and still is, one of the UK's largest automotive technical centres.

Almost one year after the opening I started work there but it nearly did not happen. I had driven down to the interview from Manchester with minimal directions and drove straight past the site as there was no signposting. The picture opposite shows the main entrance where I should have gone!

I ended up at the Ford Tractor plant that had a very obvious onion shaped water tower emblazoned 'Ford'.

I was amazed when I got the job in this "secret" establishment, especially as two of my cleverer colleagues failed the interview (one of them later became Engineering Director at Dunton).

Planning of the test centre had taken many years and the new building incorporated the functions of six or seven separate Ford divisions and cost £10million.
At that time Ford were engineering the Mk1 Escort, Cortina and Transit, emissions were only a problem in Los Angeles And the whole site had only one punched–card driven computer. There were no electronic calculators but masses of drawing boards.

Since then it has been extensively modernised and extended and is now twice the size, employing some 4500 staff (of whom only 280 are chartered engineers). They are keen to get more electricals and are encouraging internal staff to 'convert' where possible.

Cumulative investment exceeds $8.8bn with $20m annual capital investment on site, which as can be seen from the illustration, is now quite extensive.

Dunton is the Powertrain and Commercial Vehicle Centre of Excellence in Europe and the global lead for small gasoline and diesel engines. Engines, which are designed and developed in the UK, power over 60% of all Ford vehicles and have gained many prestigious awards.

Over the years the site's responsibilities have increased and in addition to Product Development include Environmental & Safety Engineering, Material Planning & Logistics, Purchasing, Information Technology & E-Business, Manufacturing Engineering, Ford Land, Marketing & Sales, Operations Staffs, Corporate Finance, Public Affairs, Ford Customer Service Division and Human Resources.

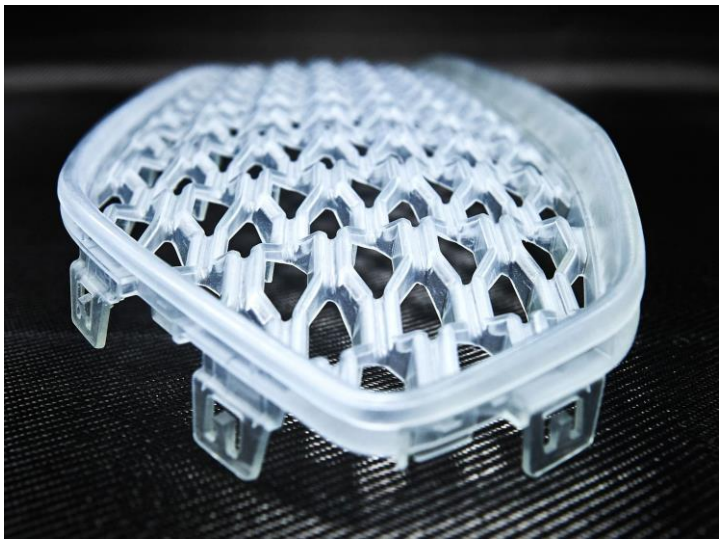
After an interesting introductory talk we visited three areas, Rapid Prototyping, The HYGE Crash simulation Facility and Environmental Testing.

Rapid Prototyping

Rapid prototyping is used in time critical scenarios to quickly produce components using 3D Printing. 3D printers produce limited runs of parts: materials used range from plastic to various metals. For the latter, lasers are used to fuse each thin layer to the one underneath, thus producing a strong metallic component. Sand printers use moulding sand and a bonding agent to make moulds for hot metal casting.

The result of this is that parts can be produced at a fraction of the cost of traditional methods.
Components can be tested, verified and modifications made very quickly, significantly reducing lead times.
Dunton also has an extensive vehicle workshop and engine prototype build area delivering hundreds of prototypes per year. We saw many of these prototypes with a very fine pattern on their exterior paintwork: this is a form of camouflage to hinder spying observers from being able to preview the exact shapes of new designs.

We saw a 'printed' plastic engine block being accurately measured by laser cameras in order to determine what small changes have to be made to the input CAD file in order to allow for stresses and strains produced within the printed plastic item.



This shows a side view of a car's front grille produced entirely on a 3D printer.

The HYGE crash simulation facility

The HYGE Sled has been operating since the early days of Dunton but with major updates in the range of sensors used. It greatly reduces the need to crash test cars during development. They use an interesting set of dummies representing various humans from 9 month old babies to full size 'rugby players'. Dummies are coloured a politically correct colour midway between white european and dark afro-caribbean.

The larger dummies all wear ‘standard’ shoes dating back to a USAF issue, which now cost $120/pair. Why wear shoes? Because they possess a degree of friction in their soles which in turn influences some of the impact transducer measurements. The larger dummies cost £45k basic or £150k when fitted with sensors (accelerometers, strain gauges, movement potentiometers). Typically there are up to 96 sensors in a dummy. Dummies are subjected to 10 ‘firings’, or a storage time of 1 year, whichever comes first, before being sent away for re-calibration.
In a test, dummies are set into a mock-up partial car, which in turn is fixed to a 5 ton sled. The sled is butted up against a VERY powerful ram which has a 10´ travel and is powered by air at 3000 psi.

Illustrated opposite is a Transit body shell mounted on the sled – the ram can be seen at the bottom left of the picture.

We were very lucky to see an actual ‘firing’ take place. Air is released into the ram cylinder, but in a controlled way in order to simulate the manner in which the real life impact energy is partially dissipated by crumple zones in a modern car. Data from a previous full impact is used to make a special piston, of varying diameter along its length. This profiled piston is attached to the ram in such a way as to restrict the rate at which air enters the ram cylinder, according to its position. Hence over a length of about 14” and a time span of about 40ms, the sled is subjected to a varying G force corresponding to that which a person in the car would experience. We were told that in our particular demonstration deceleration had peaked at about 40 G and, inter alia, had produced a chest compression of 40mm.

We also saw an airbag being inflated with a spectacular bang – all over in 40 ms.
It was sad and worrying to note that this testing facility is shortly being closed down, and a new one is being set up in the Cologne Test Centre.

Environmental testing

The Environmental Test Laboratory was built in 1999 at a cost of over £26.5 million. Covering 3500 sq. metres, the facility comprises of 4 test ‘chambers’ (2 of which are full thermodynamic wind tunnels), 6 vehicle ‘soak’ rooms and a vehicle preparation workshop. The facility is used to enable engineers to calibrate systems in most environmental conditions without the cost of shipping vehicles all over the world.

The performance of cooling and heating systems can be evaluated at extremes of climatic temperature, ranging from -40ºC to+ 55 ºC. Here we see a vehicle after a low temperature soak.

Working in such extremes is not particularly pleasant!

Although it is highly utilised over two shifts, occasionally non Ford jobs can be squeezed in. I am aware that a prototype Foggy Petronas WSB bike managed to get itself into the wind tunnel to check its cooling capability at 225kph and 40 deg C ambient. This would have involved shipping the bike and test team to Southern Italy and a very brave rider if this facility had not been available. The bike disgraced itself after 30 seconds when the engine blew up in a big way leaving the normally immaculate test chamber very oily!

When in the chamber, the cars run on Dynamometer rollers, and for the more extreme conditions involving extended running times, robots are used to operate the cars.

The chambers can simulate altitudes between 300ft (91m) below & 12,000ft (3657m) above sea level, relative humidity up to 100% and temperatures between -40ºC to+ 55 ºC.

Having got through in-chamber environmental testing, cars and drivers are then despatched to various places in the world for actual operation in real life extremes. These may show up further issues, as real life environments, though not always providing the extremes presented by Dunton test cells, do provide extra hazards such as dust, snow and rain droplets.

New test cells, being built at Ford Cologne, will attempt to simulate these additional ‘real world’ hazards.

We were shown the re-circulating air tunnel surrounding the wind test cell. The walls of the tunnel are made of ¾” steel plate in order to withstand the reduced air pressure when simulating 12,000 ft altitude. Large refrigeration plants cool the air, but they are now nearly 20 years old, and the gas they use (R507) is hard to come by as modern plants tend to use a mixture of CO2 and ammonia. Apparently Dunton uses 29 tons of R507 at a modern day price of £2m.

There is a useful You Tube video of the environmental test laboratory at https://youtu.be/5MxVxKm9FLs

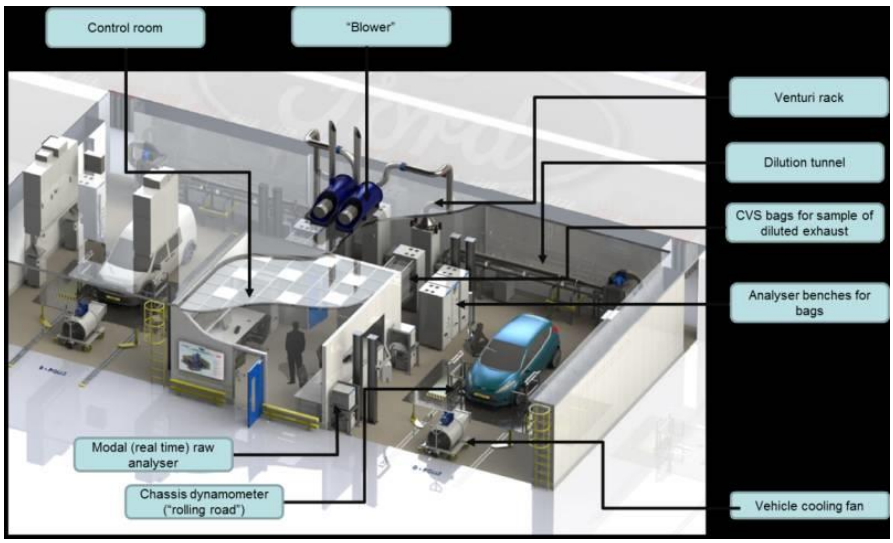
Here we see a view of a vehicle under test from the test control room.

During this visit we were not able to see neither the engine test cells nor the extensive emission facilities which are briefly described below, but hopefully this may be possible on a later visit.

Over 70 Powertrain dynamometers deliver the full range of gasoline and diesel testing, covering both development and durability testing. A number of the rooms offer a range of temperature conditions and can accommodate the full range of global fuels.

This engine on test is fully instrumented to obtain the maximum amount of data.

Emission testing is now one of the most important parts of vehicle development requiring an enormous investment in test facilities in order to show compliance with ever demanding emission requirements.



Component testing is another important part of the facilities needed to prove performance and durability targets for new cars.

Overall this was a most interesting visit and Ford considered us a most informed and inquisitive tour party. We have been invited back again to see engine development and some of the dynamometer rigs

Many thanks are due to Mike for providing the minibus (Ford of course) transport for most of us.

Ivan Farrow & Mike Wooldridge

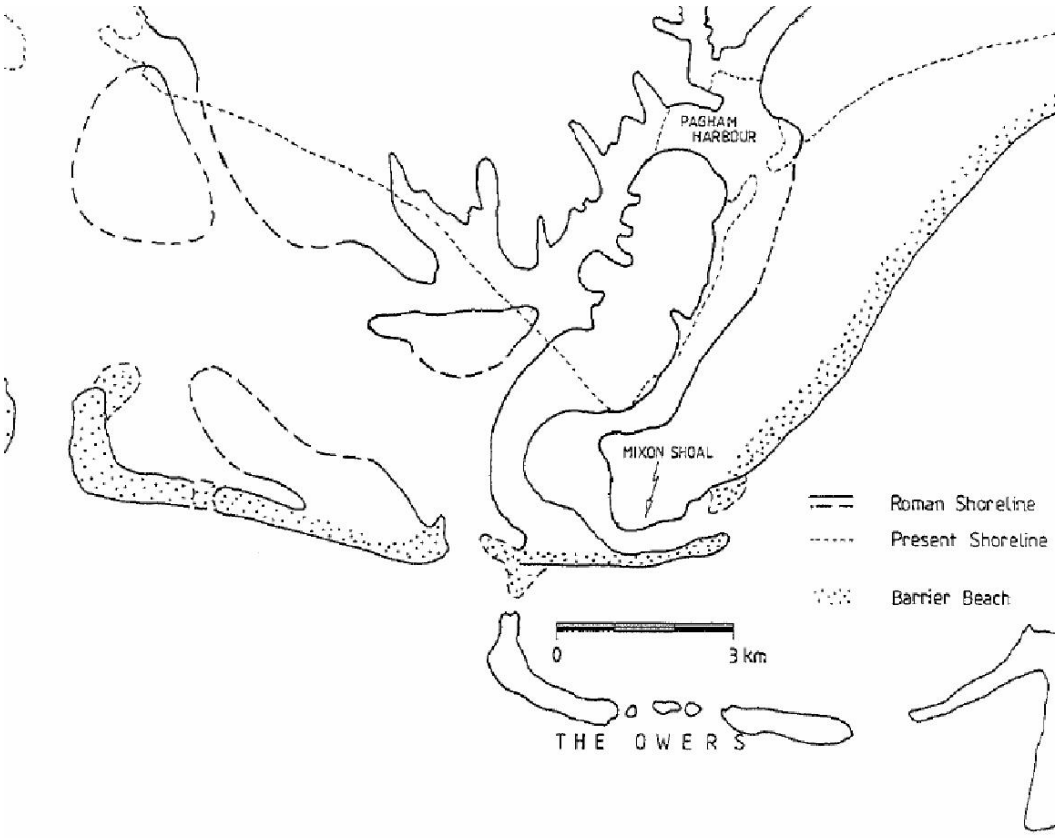
Talk

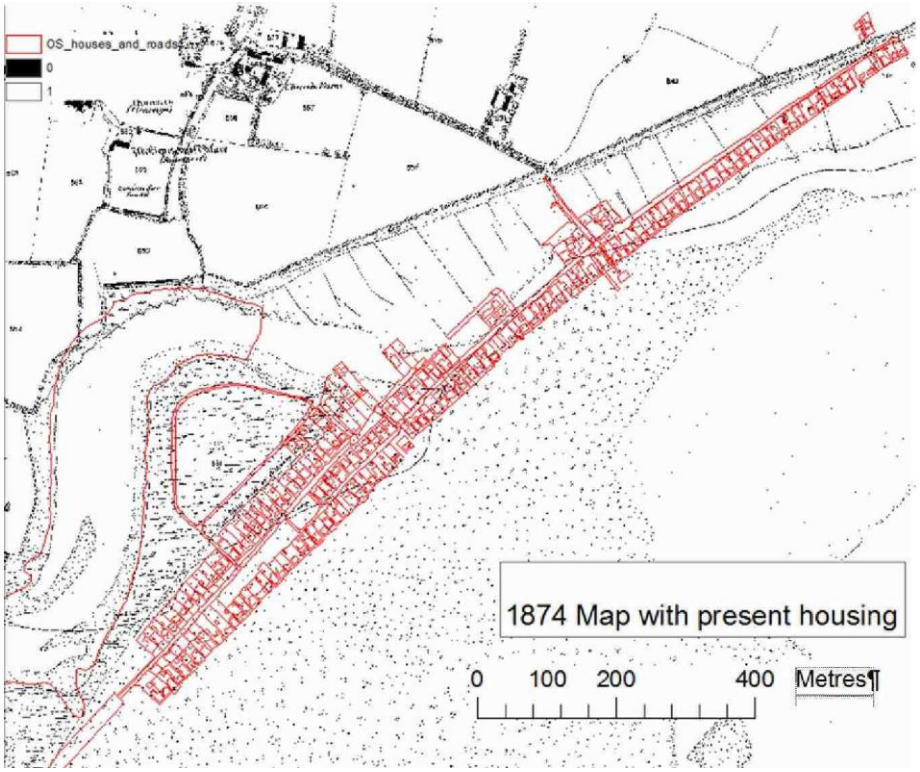
Tuesday 10th October 2017 'The coast of West Sussex – Past, Present and Future'

Uwe Dornbusch, 10 October 2017

Uwe Dombusch works for the Environment Agency as a senior specialist in Coastal Flood and Erosion Management.

He presented a number of photos, videos and graphs showing how the Sussex coast has undergone significant change not only over tens of millennia but also in the more closely documented period since Roman times. The picture opposite shows the erosion around the coast off Selsey: it will be noted that the shoreline has receded by between 3 to 6 Km.





The Chichester harbour /Selsey Bill/Pagham harbour coastline does seem to be especially 'active'. The picture opposite shows the outline of present day coast-facing houses in Pagham, superimposed on an 1874 map of the area. During this time the harbour entrance has moved some 1000m to the SW, prompting the urban development shown, and leaving a lagoon behind said houses.

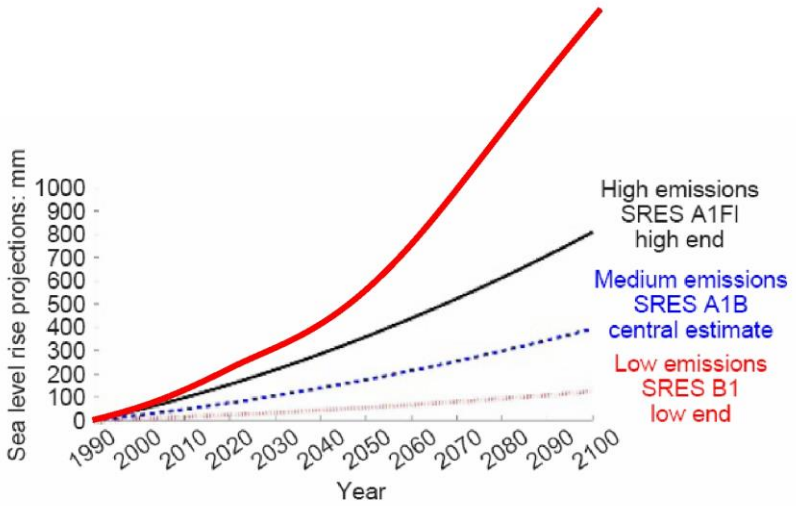
Uwe showed a number of photos illustrating how the sea tends to have its own way, especially in low lying coastal areas, despite attempts by man to control things. The picture opposite shows the narrow shingle ridge topped with a small stub wall at Atherington being overwashed by a large wave at high tide.

(Uwe had to wait for 10 minutes to capture a wave high enough to overtop the wall.)

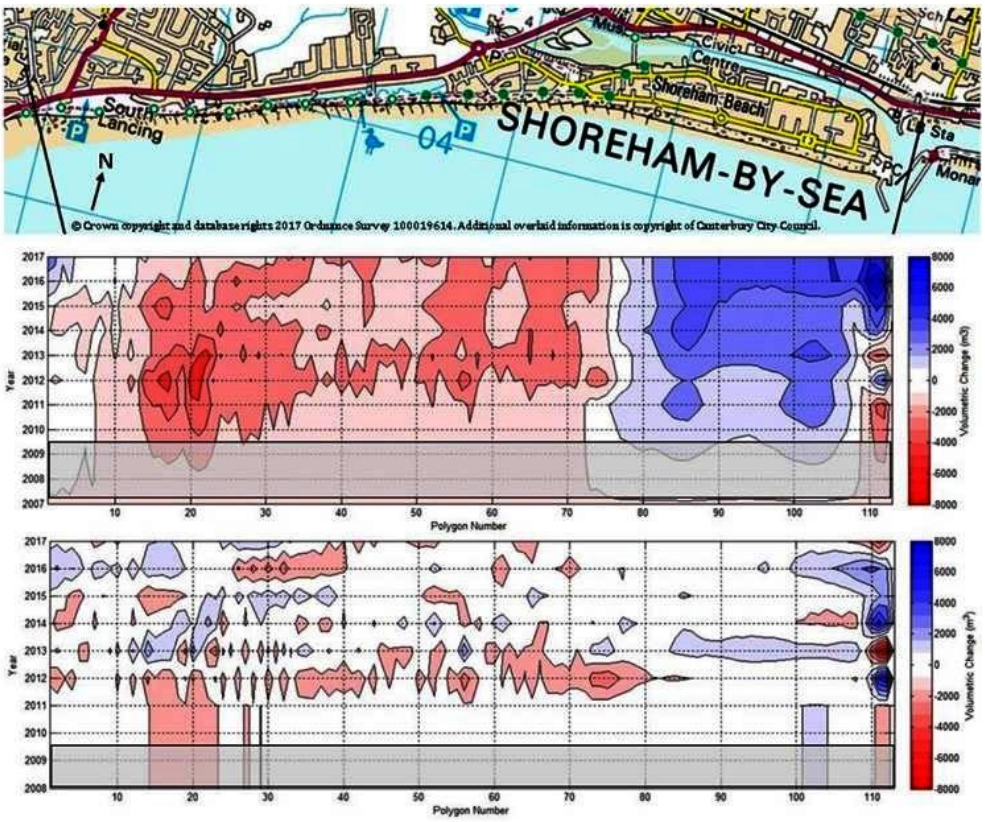
The picture opposite illustrates the frequent recycling work needed to keep shingle in its 'desired' place - typically determined by local housing and road building developments. The erosion shown here can take place over just a few tides.

Uwe later attempted to sum things up by saying "increasingly we have to decide if we want to keep houses where they are, or preserve the beaches, but not both", implying that holding beaches can demand hard engineering structures (e.g. concrete pouring) – and even these can be eroded and require toe protection and further extension. Another significant consideration, leading to variations in erosion behaviour, is the nature of the beach material itself. Large shingle behaves differently from sand, whilst the prognosis for a mixture of materials in between is even harder to model.

Uwe discussed the effect of rising sea levels. The picture opposite shows predictions of sea level rises over the period 2000 to 2100, varying from 100mm to 700mm depending upon how nations manage to control emissions of greenhouse gas. There is also a rather worrying red line showing a possible 2m rise over this period should the melting of ancient ice significantly accelerate. A new report on the impact of future climate change is anticipated for 2018 which will include a better understanding of the contribution that melting ice from Greenland and Antarctica will make.



The presentation was followed by a lively debate prompting our speaker to show some more illustrations in response to detailed questions as follows.



YEAR ON YEAR (BOTTOM) AND CUMULATIVE (TOP) CONTOUR PLOTS FOR BEACH VOLUMETRIC CHANGE IN LANCING 2007-2017

In response to a question about Litoral Drift and its impact on the beaches either side of the Shoreham harbour entrance, Uwe produced a most detailed map opposite showing precisely how the shingle builds up on the west side of the harbour. Shoreham Port currently finds they have to spend in the order of £150k/yr moving this shingle from west to east. This is necessitated by the need both to protect their beach-facing buildings on the east side from damage resulting from wave action as their foundations become progressively more exposed, and to prevent shingle entering the harbour entrance which would otherwise have to be dredged due to sediment coming from the west.

The need to move shingle that has been washed along the coast by wave action is a constantly occurring problem. Shoreham Port currently use diggers and lorries as illustrated opposite. A method that shows a more dramatic way of moving shingle is also shown: shingle, dredged from offshore, is 'rainbowed' onto the beach from a ship.

It was a most interesting talk with a correspondingly large (77) audience. Clearly Uwe and his colleagues have an interesting and never ending job advising the various coast-facing authorities on the technical options for dealing with the all-powerful, restless sea.

MW Nov 2017

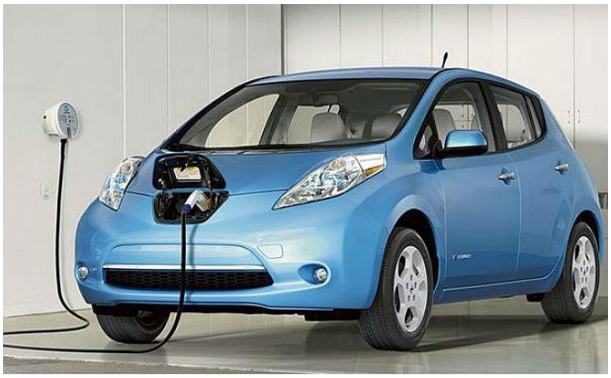
Talk
Tuesday 14th November 2017 – 'Don't buy an electric car'

Professor Averill Macdonald, University of Southampton

Professor Macdonald apologised for the absence of her co-presenter, Professor Alun Vaughan who was not able to attend. She opened her talk by stating that she had nothing against electric cars and saw them as a very attractive proposition for reducing pollution levels in towns. However if everyone bought an electric car, far from being a benefit to our environment, there would be serious consequences for the UK's electricity supply.

The majority of the UK's electricity is still generated from fossil fuels (coal and gas) as shown opposite. In showing this picture, our speaker did accept that most of the visible emissions from the cooling towers are steam, but obviously the plume from the chimneys adds to pollution. As the majority of present day electric cars require charging from the grid, we effectively shift the source of pollution from the road to the power station.

The electric car isn't quite the clean option we like to think, particularly when we take into account the materials and processes required to build the car and, particularly, the battery itself.



The most popular electric car, the Nissan Leaf, shown opposite, has a claimed range of 124 miles and a practicable range of about 90 miles before the driver experiences 'Range Anxiety'. In cold weather the achievable range can be even less. Once discharged the battery requires 6 – 8 hours charging at 3kW from a standard 13A plug. This is known as slow charging.
Fast charging can be achieved from a special outlet providingvehicles, 75A allowing a full charge in 3 hours (the connector to be installed professionally at a significant cost to the user).

There are also proposals to install rapid chargers providing 125 A and giving 80% charge in 30 minutes, which could be useful if away from home with a partially discharged battery. One problem for people without off-road parking is that it isn't possible to trail a cable from your house to your car parked in the road, so specialised charging points will have to be installed in areas where cars have to be parked in the road. Even if these charging problems can be overcome, the major problem is the effect that large numbers of electric vehicles would have upon the grid.

Professor Macdonald then presented the calculation opposite, showing that currently the national grid is capable of providing approximately 1KW of electrical power per person. In the UK there are around 32 million cars on the roads. If only a third of us bought electric cars, equating to about 10 million vehicles requiring charging, the majority overnight on a 32A charger, the connected load would be on average say 80 GW.
During the summer our lowest demand is about 40GW, but on a winter's night we currently need 55 GW. We would have to substantially raise the grid's reserve generating capacity to find another 80GW for all these electric vehicles.

UK maximum demand = 60GW 6×10^{10} W

UK population = 60 Million 6×10^{7} person

Electricity use per person $\frac{6 \times 10^{10}}{6 \times 10^{7}}$ Wp^{-1}

Average power use per person = 1×10^{3} W

or 1 kW each

A further problem arises with the cables under our roads. The current we draw to run everything in our houses is transmitted along underground cables. When the national grid (shown opposite) was put in in the 1960's, houses had far fewer electric gadgets. Typically the cables in the road can carry 100kW for 10 houses (10 kW maximum demand expected per house). If half of those houses bought electric cars and recharged them using a 32A supply, then the demand would be 5 cars x 8 kW on average = 40kW. Add this to the current level (10 houses x 10 kW) + (5 cars x 8 kW) = 140kW.

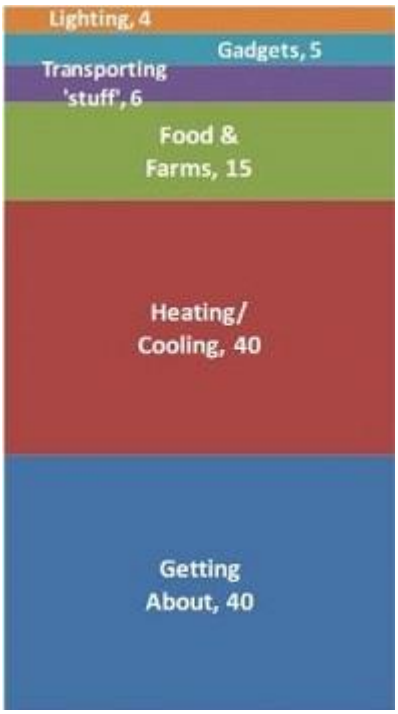
So the cables under the roads would need to carry far higher currents than they were designed to do. If many of us bought electric cars, then the cables under the roads would have to be replaced – with all the inconvenience and cost that that entails.

The speaker accepted that with sufficient investment and time these problems could be overcome.

However the reason we want electric cars is to reduce pollution and our reliance upon fossil fuels. But cars and transport are only a small fraction of our total energy usage. An important additional contributor is heating for houses: at present, 84% of homes have gas central heating and use 300GW of power for heating in winter. If we were to rely totally on electric heating, it would cost c. £15k per house to convert them, and we would need to convert one house every second to complete the work by 2050, with a total cost of £300bn.

As an individual you currently use about 100 kWh energy in total each day, of which about 20kWh is electricity. The forecast is that you will use about 140kWh energy each day in the future.
So for every person in the UK we need to plan to be able to provide 140kWh of clean energy, probably by electricity generated from renewable sources. In order to do this, we would need:

- 60,000 wind turbines – most of them offshore
- Half of all the roof area in the country covered with solar panels
- 5 new nuclear power stations
- 1000km of wave machines along the coast
- Re-insulate almost all the nation's homes
- Flood the Severn Estuary…and
- Give over about 25% of the UK's food-producing land over to energy crops



Just looking at the need for 60,000 wind turbines averaging 2MW by 2025, implies putting up 15 turbines per day –> 1 per hour!

To go green – being able to provide all our energy needs from sustainable sources – we will need to spend lots of money building the generating capacity and 'rewiring' the grid to transmit the energy to our homes and to charge our cars.

So can we do it? Well there are a number of hopeful signs:-

- We know how to generate electricity
- We are installing more wind turbines
- The efficiency of photovotaics is rising
- The second generation of smart meters should enable the power companies to control demand
- China is planning to build 100 nuclear reactors by 2030 to very similar specifications, a process that will benefit them hugely due to economies of scale. Perhaps in the future China will be one of the dominant players in nuclear energy and we can buy some affordable nuclear power stations from China?
- The concept of 'localised energy', or moving the generation, storage, and distribution of electricity down the chain to towns and communities is gaining popularity, partly due to subsidies that used to be given out to those who installed solar panels on their homes. Companies like Solar City, and arguably Tesla with their 'supercharger' network, are attempting to become distributed utilities, taking the load off the national networks.
- One of the more futuristic possibilities is an *international* electricity grid enabling countries to trade power over, so that we can generate vast amounts of solar energy in the Sahara Desert, wind energy in the North Sea, hydro-electric power in the mountains of Scandinavia, and so on. This would require cables capable of carrying tens of gigawatts of power, over thousands of miles, almost certainly using High Voltage DC transmission.

So we might be able do this, but it's going to be very expensive and will take far longer that current plans allow.

Are there alternatives?

Attempting to predict the future is always difficult, but currently one possibility that is gaining support is to move over to a hydrogen economy.

Hydrogen can be produced in a number of ways: currently the dominant technology for direct production is steam reforming from hydrocarbons, but other methods are known including electrolysis.

Hydrogen can power cars, and some hydrogen powered vehicles are currently in operation, but much work is still needed before hydrogen could become a viable means of powering cars, not least on the infrastructure where in the whole of the UK we only have a handful of hydrogen 'filling' stations. Other countries, including Germany and Japan, are far more advanced than we are. The Toyota Mirai hydrogen car is currently in production (with some 2 dozen sold so far in the UK). It is also understood that Hyundai's ix35 is also in production, and the Honda Clarity is promised for later in the year. All of these hydrogen-powered cars use fuel cells to convert the hydrogen fuel into electrical power as opposed to burning the hydrogen in an internal combustion engine.

Hydrogen can also heat the home by relatively minor modifications to conventional gas boilers. In fact before we had North Sea gas, 'town' gas was 50% hydrogen. The UK is particularly well placed to 're-purpose' its extensive gas supply network to distribute hydrogen.

There are a number of city busses, airport vehicles, and a demonstrator train that run on hydrogen.

The Leeds Citygate project describes converting a whole town to hydrogen.

Hydrogen can also be seen as a rival to batteries for storing surplus grid power. It has been suggested that abandoned salt mines could be used to store hydrogen.

This was a very thought provoking talk attracting a large audience and considerable discussion.

End of Newsletter

REPLY SLIP

To:George Woollard 18 St Lawrence Ave, Worthing, West Sussex BN14 7JF (01903 523640)

E Mail : Georgewoollard1@hotmail.co.uk

Can you please reserve me …….. places for the Spring Lunch at Northbrook Collage, Worthing on ***Wednesday 18th April 2018.*** 12.00 for 12.30.

Full name:……(Block capitals)

Address………

……

……

Telephone Number…….Name of guest/s …….

E mail address……

I enclose a cheque made payable to RCEA for **£…….(£15.00) per person**

(Separate cheque for this event please)

Applications by Friday 6th April

If possible, I would like to be seated with……..

REPLY SLIP

To: Ivan Farrow, 14, Ring Road, Lancing, W Sussex BN15 0QF

Email: ivan_farrow @yahoo.com

I would like to attend the visit to Ford Dunton on Thursday 3rd May 2018.

Please reserve me a place.

RCEA member …….. Guest ……. Full name:.....(Block capitals)

Address.....
.....
.....

Telephone Number.....

Email address.....