Construction site case study and application of Guidance

IAQM Seminar on
‘Reviewing the guidance on dust control from Construction’
BRE
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Presentation

- Background
- Importance of controlling pollution from construction
- Case study
- Examples of pollution control
- Pollution Control Guides and subsequent guidance
- Summary
- Areas for further improvement
## Current UK Air Quality Objectives for airborne particles

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Concentration</th>
<th>Measured as:</th>
<th>To be achieved by</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{10}$ All authorities</td>
<td>50 µg m$^{-3}$ not to be exceeded more than 35 times a year 40 µg m$^{-3}$</td>
<td>Daily mean  Annual mean</td>
<td>31 Dec 2004 31 Dec 2004</td>
</tr>
<tr>
<td>PM$_{10}$ Scotland only</td>
<td>50 µg m$^{-3}$ not to be exceeded more than 7 times a year 18 µg m$^{-3}$</td>
<td>Daily mean  Annual mean</td>
<td>31 Dec 2010 31 Dec 2010</td>
</tr>
<tr>
<td>PM$_{2.5}$* All authorities</td>
<td>25 µg m$^{-3}$ (target) 15% cut in urban background exposure</td>
<td>Annual mean  Annual mean</td>
<td>2020 2010 - 2020</td>
</tr>
<tr>
<td>PM$_{2.5}$* Scotland only</td>
<td>12 µg m$^{-3}$ (limit)</td>
<td>Annual mean</td>
<td>2010</td>
</tr>
</tbody>
</table>

* Not included in regulations at present

Source: UK National Air Quality Archive: Air Quality Standards
Importance of controlling pollution emissions from construction

- Airborne Particles Expert Group (APEG) estimated 4% of total UK particle emissions from construction sites
- Construction sources can dominate local environments
- Typically ~ 8,000 complaints/year to LAs about noise from construction and demolition work
Pollution from construction - Effects on Health

- Particles, vapours and noise emissions can adversely affect health (mostly occupational, but possibly also some local population effects):
  - Irritation to eyes, nose, respiratory tract
  - Skin ailments by deposition
  - Respiratory and cardiovascular disorders
  - Increased mortality
  - Impairment of hearing
Pollution from construction - Effects on the Environment

- Effects of particles, vapours and noise emissions on the local environment:
  - Reduced air quality
  - Poor visibility (extreme conditions only)
  - Damage to plants and crops
  - Disturbance of local wildlife
  - Soiling of surfaces (property, washing, cars etc.)
  - Nuisance to local residents
Benefits to industry from ‘Good Environmental Practice’

- Potential for increased business and improved profit margins through
  - Better local environment quality, health and fewer complaints
  - Reduced costs of cleaning and repairing damage
  - Avoiding costly delays in dealing with enforcement notices and defending prosecutions
  - Meeting sustainability targets by protecting health and environment
  - Demonstrating corporate environmental responsibility
  - Better workforce relations
  - Repeat business
BRE project background

• Need for common guidance was identified by industry and regulatory authorities.

• Two projects: both led by BRE in collaboration with government, industry and regulatory authorities.

• Initial project set up to develop draft guidance on controlling emissions from construction and demolition.

• Followed by 3-year project to test (where possible) and refine the draft guidance:
  • Case study conducted over 18 months, covering the full life-cycle of a contaminated construction site, to evaluate site emissions during various phases, processes and controls.

• New “Pollution Control Guides” produced to meet industry requirements:
  • simple and easy to use
  • widely accessible and for use by all concerned

• Information subsequently incorporated into the London Councils ‘Best Practice Guidance’
Case study construction site - details

- Semi-rural area
  - no large nearby buildings
  - lower background pollution levels than city centre
- Old chemical works (contaminated site - arsenic)
- Site area = 6500 m²
- All buildings demolished and removed
- At least 1 m depth of soil removed from site area
  - samples taken for analysis of contaminants
  - maximum depth removed = 13 m
- Site in-filled and levelled
- Construction of new buildings (sympathetic to demolished buildings to maintain area character)
Case study construction site - monitoring

• Complete construction cycle covered (site-preparation, demolition, earthworks, construction, finishing, occupation)

• Continuous monitoring for 18-months of:
  • Fine particles (PM$_{10}$) at 3 locations around the site (one monitor at the site boundary ~1 m away)
  • Meteorological conditions

• Also measured/recorded:
  • deposited dust (weekly)
  • Site activities (weekly)
  • VOCs (monthly)
  • ultrafine particles (occasional)
Layout of construction site and monitoring stations

- Station #1: 100m from site centre
- Station #2: 100m from site centre
- Station #3: Canalside
Monitoring station (#1) - during demolition period
Demolition and Earthworks – processes and controls

• Demolition
  • Buildings “nibbled” down using grabs
    • no explosive or impact methods used
  • Demolition from centre of site outwards
    • buildings at site perimeter provide some screening (mostly acoustic) until demolished themselves
  • Materials sorted and removed from site
  • 310 recorded truck movements during 8 weeks
  • Manually-operated water sprays used to control dust
  • Wheel-washing plant used

• Earthworks
  • Hydraulic sheet piling at site perimeter (low noise)
  • 1400 recorded truck movements (exiting from site) during 8 weeks
  • Wheel-washing plant and manual wheel-washing used
Demolition - “nibbling” down buildings
PM$_{10}$ concentrations during demolition – effect of water sprays

Initial (uncontaminated) building demolished before installation of water-spray systems and run-off control (Week 1 of monitoring)
Demolition - initial water spraying method

Water jets attached to demolition plant
Demolition - final water spraying method

Water spray under hand-held control
Benefits of hand-held water spraying

- Pre-wetting building while demolition plant is working elsewhere
- Spray can be directed at freshly exposed surfaces while demolition plant is sorting materials
- Water easily shut off. Reducing usage and amount of potential run-off
- No additional staff-costs, as operator required to be present anyway (for moving hose fixed to demolition plant)
Wheel-washing of lorry exiting site

Automatic wheel-washing plant

Manual wheel washing
Hydraulic sheet piling at site perimeter

- 10 m sheet pile
- Occupied houses
- Hydraulic press and power plant
- Support crane
Earth-working
Building construction– processes and controls

- Auger piling (low noise) for building foundations
- Silo for storage of cement
- Off-site construction of building components (roof timbers, windows etc)
- Blocks and other materials kept polythene-wrapped until required
- Bench with water sprays for dust control used for cutting blocks (standard disc cutters not permitted on site)
Auger piling (low noise) for building foundations
Construction of new buildings

- Pre-fabricated roof sections
- Polythene-wrapped blocks
- Cement storage silo
- Bench for block cutting
PM$_{10}$ - 24-hour averages (all construction phases)
PM$_{10}$ monitoring – summary (1)

- Only 5 exceedences of national 24 hour PM$_{10}$ air quality standard of 50$\mu$g m$^{-3}$ at site boundary during the 18 months of operation
  - all associated with higher air pollution episodes as well as construction activity

- During working hours PM$_{10}$ levels were raised at site boundary by:
  - $\sim$ 3 $\mu$g m$^{-3}$ during site preparation
  - $\sim$ 11 $\mu$g m$^{-3}$ during demolition
  - $\sim$ 5 $\mu$g m$^{-3}$ during piling and earth-working
  - $\sim$ 2 $\mu$g m$^{-3}$ during construction of new buildings
PM$_{10}$ monitoring - summary (2)

- PM$_{10}$ levels ~150 m from construction site were indistinguishable from background levels

- Much of PM$_{10}$ seemed to come from vehicle and plant engine emissions
Case study - Summary

- No complaints were received at either the site or at the local authority during 18 months of operation
  - Allowed site operations to continue uninterrupted
  - Despite sensitivity of site and vigilance of local ‘Action Group’

- Site was tightly run to best practice methods
- Earth-working period was through winter when ground and materials were usually moist
- PM$_{10}$ levels raised at site boundary by approximately 2-10 μg m$^{-3}$ depending on operations, but undetectable 150m downwind
- Deposited dust levels highest at site boundary and during demolition and construction phases
BRE Pollution Control Guides for dust, vapours and noise from construction
BRE Pollution Control Guides – 5-part set

- **Part 1**: Pre-project planning and effective management
- **Part 2**: Site preparation, demolition, earthworks and landscaping
- **Part 3**: Haulage routes, vehicles and plant
- **Part 4**: Materials handling, storage, stockpiles, spillage and disposal
- **Part 5**: Fabrication processes and external and internal finishes
Further guidance for controlling emissions from construction

• London Councils Best Practice Guidance ‘The control of dust and emissions from construction and demolition’ (2006)
  - Largely based on BRE’s ‘Pollution Control Guides’ and other publications
  - Contains additional guidance on Air Quality Impact Evaluation for defining sites as Low, Medium or High Risk

• Engine exhaust from Non-Road Mobile Machinery (NRMM) and other plant at construction sites
  - Guidance from consortium of PRECIS, EST, SMMT and EIC on the fitting of pollution control devices to construction machinery.
  - EST has developed a formal register of approved devices for exhaust emission control on NRMM

• Relevant Process Guidance Notes e.g. Mobile crushing and screening PG 3/16 (04); Blending, packing, loading, unloading and use of bulk cement PG 3/01 (04).
Conclusions

• Pollution emissions (particles, noise & vapours) can be minimised at construction sites by following good practice guidance

• Incorporation of appropriate pollution control measures is required:
  • At design and tender stages (costs)
  • Within method statements for enacting at site

• All emissions (process and engine exhaust) must be controlled at source

• Any monitoring must be continuous

• Combustion emissions from vehicle / plant engines on site must be carefully controlled – good progress already made in this area

• Case study covered only 1 site in semi-rural area. Large, complex sites in urban areas can lead to local exceedences of AQ standards
Areas requiring further improvement

• Monitoring – currently rarely required, even when sites are within AQMAs
  • Local pollution exceedences not recorded
  • Source apportionment not possible (either within site or from other sites/sources)

• Source terms (emission rates) from specific processes are not known
  • Relative contributions of specific processes (particle size distribution and mass concentration) to overall emission rates from sites are not known
  • Effectiveness of control methods therefore cannot be quantified
  • Reduced accuracy of modelling of likely emissions from proposed sites and possible effects on local air quality

• Remediation of contaminated waste from sites
  • Currently is often effectively landfill to special sites
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