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THE EVOLUTION OF MINES AND QUARRIES REGULATIONS FOR EXCAVATIONS AND TIPS

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ABSTRACT

Legislation for excavations and tips in mines and quarries has become more complex as risk management systems have improved. This paper reviews the evolution of pertinent legislation related to excavation and tips, whilst identifying effective implementation strategies for safer design.

More than a quarter of a century has passed since the inception of the Quarries Regulations 1999 (QR99), and over a decade since the introduction of the Mines Regulations 2014 (MR14). Therefore, it is relevant to reflect upon the evolution of those regulations where they govern excavations and tips. Influenced by new design standards such as Eurocode 7, significant advancements have reshaped ground-related risk assessment and management at mines and quarries in the UK.

The foundations of geotechnical control in QR99 and MR14 lie in the cornerstone of defining appraisal and assessment. However, as modern asset management techniques continue to evolve, these regulations may appear less adaptable to contemporary practices such as those defined in the Eurocode and the Construction (Design and Management) Regulations 2015 (CDM15). By examining practices in sectors such as construction earthworks, reservoir design and infrastructure management valuable lessons emerge regarding competency, inspection procedures, and asset management systems aimed at controlling ground-related risks.

This paper delves into a comparative analysis of QR99, MR14, and other regulatory approaches in an attempt to shed light on emerging practices and safety management systems for excavation and tips. It is supplemented with insights from innovative design procedures, cross-industry best practices, and regulatory benchmarks. Furthermore, the integration of modern technologies holds promise in augmenting safety performance indicators.

As we navigate through the realm of evolving regulations and technological advancements, the pursuit of continuous improvement remains paramount in ensuring excavations and tips at mines and quarries are safe and secure.

INTRODUCTION

Legislation for excavations and tips in mines and quarries has become more complex since the turn of the century. The aim of this paper is to review their development to enable practitioners to adopt more effective ways to achieve safe design and implementation within the myriad of statutes, codes of practice, and guidance.

As the Quarries Regulations 1999 (QR99) have crossed the quarter-century mark since their inception, it is imperative to reflect upon the evolution of UK regulations governing excavations and tips at mines and quarries. With the introduction of the National Planning Policy Framework in 2012, the Mines Regulations 2014 (MR14), and new design standards like Eurocode 7, significant advancements have reshaped the landscape of ground-related risk assessment and management in the UK. There are numerous stages involved in excavations and tips, from planning to design, construction, inspection, monitoring, maintenance and notification procedures. This paper is focused on the design aspects and delves into a comparative analysis of QR99, MR14, and other regulatory approaches, shedding light on emerging practices and potential areas for improvement.

THE ORIGIN OF UK EXCAVATIONS AND TIPS REGULATIONS

The baseline of this paper commences with The Mines and Quarries Act, 1954. In this Act, ‘Management and Control’ and ‘Safety, Health, and Welfare’ were clearly divided into Parts II and III (related specifically to Mines) and Parts IV and V (related specifically to Quarries).

It is noteworthy that the word 'tip' did not occur at least once in the 1954 Act. Furthermore, references to 'refuse' were confined to the surface storage of such material removed from a quarry or mine on premises exclusively occupied by the owner of that mine or quarry; 'waste' provisions related to withdrawal of support, ventilation and danger from gas in waste.

'Excavations' were divided into the separate definitions of a 'mine' (wholly or substantially by means involving the employment of persons below ground) and a 'quarry' (being neither a mine nor merely a well or bore-hole or a well and bore-hole combined).

For mines, it was the duty of the mine manager to take steps to control movement of the strata in the mine and support the roof and sides of every road or working place as may be necessary for keeping them secure. There were also provisions for support rules and systematic support in mines, in particular for but not exclusive to coal, shale and fireclay mines.

For quarries, it was the duty of every manager of a quarry to secure that any quarrying operations were carried on as to avoid danger from falls (of ground) and that in no part of the quarry shall the face or sides of the quarry or any gallery be worked as to cause any overhanging.

References to 'design' in the 1954 Act were made in relation to safety barriers, access prevention measures, ignition devices, safety devices in vehicles and blasting materials. There were no outright references to design of excavations and tips.

The 1954 Act was supplemented by the Quarries Order 1956, which reenacted provisions of the Quarries General Regulations 1938 in a schedule cited as the Quarries General Regulations 1956. Amongst the provisions were daily inspections and safe methods of working of the face, side and overburden of the quarry.

It took the unmitigated disaster of a colliery spoil tip failure and the resultant loss of 144 lives (including 116 children) at Aberfan, Wales on 21 October 1966 to change the direction of regulating excavations and, more particularly, tips at mines and quarries.

The onset of regulations specifically related to tips in mines and quarries came in the Mines and Quarries (Tips) Act 1969. Again, there were no specific references to design of excavations and tips in that Act. However, it did differentiate tips associated with mines and quarries from disused tips constituting a danger to members of the public (Table 1). This disassociation was to come to the fore many years later, as discussed in a subsequent section (Welsh Government, 2024a).

Table 1. Definitions of Tips - Mines and Quarries (Tips) Act 1969

Name	Definition
PART I SECURITY OF TIPS ASSOCIATED WITH MINES & QUARRIES	
Tip	an accumulation or deposit of refuse from a mine or quarry (whether in a solid state or in solution or suspension) other than an accumulation or deposit situated underground…
Active tip	a tip on premises which are deemed to form part of a mine or quarry for the purposes of the principal Act…
Closed tip	a tip not on such premises but the mine or quarry with which it is associated has not been abandoned and the premises on which the tip is situated continue to be occupied exclusively by the owner of that mine or quarry…
PART II PREVENTION OF PUBLIC DANGER FROM DISUSED TIPS	
Disused tip	a tip, which is neither an active nor a closed tip….

In simple terms, active and closed tips were deemed the responsibility of owners (operators) and disused tips the responsibility of local authorities, including disused tips from former coal mine operations.

Within two years the Mines and Quarries (Tips) Regulations 1971 introduced detail on the construction (and tipping rules) and inspection of tips, accompanied by the Mines and Quarries (Tipping Plans) Rules 1971. Also, Part I active and closed tips in the 1969 Act were split according to their state of deposition and defined as "classified tips" i.e. tips which because of their size or location are more likely to present a potential hazard. Part II disused tips were omitted and therefore remained under the auspices of local authorities.

Table 2. Definitions of Classified Tips - Mines and Quarries (Tips) Regulations 1971

Type	Definition
Accumulated or deposited wholly or mainly in a solid state and not in solution or suspension	(i) the superficial area of the land covered by the refuse exceeds 10,000 square metres; or (ii) the height of the tip exceeds 15 metres; or (iii) the average gradient of the land covered by the refuse exceeds 1 in 12;
Accumulated or deposited wholly or mainly in solution or suspension	(i) any part of the tip (other than any wall or other structure retaining or confining it but including any liquid in it) is more than 4 metres above the level of any part of the neighbouring land within 50 metres of the perimeter of the tip; or (ii) the volume of the tip (other than any wall or other structure retaining or confining it but including any liquid in it) exceeds 10,000 cubic metres:
"active classified tip" and "closed classified tip" shall be construed accordingly	

It was declared that every active and closed tip shall be kept efficiently drained (Part II, clause 4) and for classified tips, tipping operations shall not be begun until the owner of the mine or quarry has obtained a report from a person competent to make the report on the methods of tipping and all matters which might affect the security of the tip, including the land on which it is to be constructed, in particular:

(i) the designed total amount of refuse to be deposited and average amount per week;
(ii) an account and results of any surveys, tests, boreholes and ground water measurements;
(iii) details of site preparation, drainage and foundations of the intended tip;
(iv) accurate plans on a scale of not less than 1/2500 and sections on a scale of not less than 1/1250 of the intended tip to show the designed types of refuse to be deposited and height, contours and boundaries of the tip, and any retaining structure and the superficial area and gradients of the land to be covered by the refuse.

In effect, the above tantamounted to a tip design statement being an absolute requirement prior to commencement of tipping. For the first time, design of tips was clearly identified and specified in statute.

No such design standard was specified for excavations at the time, being the 1969 Act and 1971 Regulations were limited to tips. However, were the legal principle of equivalence to have been applied then the owner would have been expected to obtain a pre-commencement design report from a person competent on the methods of excavation and all matters which might affect the security of the excavation.

THE DEVELOPMENT OF UK REGULATIONS FOR EXCAVATIONS AND TIPS

The Quarries Regulations 1999 (QR99) and The Mines (Control of Ground Movement) Regulations 1999 represented the first major development and to an extent, diversion, from historical legislation. For the first time, excavations and tips in mines were effectively treated separately from those in quarries.

The QR99 also introduced an Approved Code of Practice and Guidance (ACOP) document published by the Health and Safety Commission, now known as Health and Safety Executive and referred to hereinafter as the HSE. Whilst somewhat prescriptive, the regulations and ACOP clarified expectations (in a legal context) and provided practitioners with some direction and a reduction in ambiguity. The QR99 ACOP includes a dedicated PART VI

Excavations and tips (Regulations 30-38). The overriding responsibility of the operator is to ensure that excavations and tips are designed, constructed, operated and maintained so as to ensure that:

(a) instability; or
(b) movement,
which is likely to give rise to a risk to the health and safety of any person is avoided.

Unlike other regulations which include the term ‘as far as reasonably practicable’, QR99 Regulation 30 requires the design and management of excavations and tips as an absolute duty. The ACOP and guidance (clause 254) are clear in that all excavations and tips, however small, must be designed, constructed and maintained to ensure their safety, proportionate to the danger the excavation or tip poses. This involves considering issues such as drainage and the method of construction.

In relation to the safety of excavations and tips, the most important new design-related provisions within QR99 introduced:

- unlike the aforementioned 1969 Act and 1971 Regulations the QR99 cover all tips at a quarry, including soil bunds, overburden dumps, stockpiles and lagoons.
- requirements for appraisals (to determine whether an excavation or tip poses a significant hazard from collapse or movement) and geotechnical assessments (Regulations 32 and 33)
- competence – definition of geotechnical specialist (see Table 4)
- Schedule 1 Content of geotechnical assessments
- Appendix 3 Excavation and tip inspection reports – customisable check list and form of report

Under QR99 Regulation 32, meanings of classified tips in the 1971 Act (see Table 2) were essentially upheld in the ACOP and re-defined as significant hazards (Fig. 1) with specific geotechnical assessment, reporting and monitoring regimes. For excavations, significant hazards are defined by the ACOP where:

(a) in…moderately weak or stronger rock (i) the vertical height of any individual face is > 15 m or (ii) the overall vertical height of any adequately benched face… is between 15 m and 30 m, and the overall face angle is steeper than 1 horizontal to 1 vertical (45° to the horizontal); or

(b) in …weak or very weak rocks and engineering soils, the vertical height of any part of an excavation is > 7.5 m, and the overall face angle is steeper than 2 horizontal to 1 vertical (27° to the horizontal); or

(c) the bottom of the excavation is > 30 m below any surrounding land within 30 m of the perimeter of the excavation (i.e. the excavation is more than 30 m deep…); or

(d) …other factors…mean that there is a significant hazard as described in paragraphs 293-295.

QR99 ACOP paragraph 295:

‘the hazard should be considered significant if such a failure would, directly or indirectly, be:
(a) liable to endanger premises, roadways or other places where people are likely to be found off-site; or
(b) likely to kill or seriously injure anyone’.

Figure 1. Significant hazard – failure of excavation or tip

Regulation 7 specifies the health and safety document, to include the excavations and tips rules required by Regulation 31, and the conclusions of any appraisal or geotechnical assessment of an excavation or tip undertaken in accordance with Regulations 32 and 33.

The Mines (Control of Ground Movement) Regulations 1999 enhanced ground control in mines with responsibilities for:

- The taking of ground control measures (Regulation 4);
- the assessment of ground conditions and its review and revision (Regulation 5);
- the preparation of a design document and its review and revision (Regulation 6);
- rules for ground control measures and instructions on how to implement them (Regulation 7)
- Schedule of support system standards for coal mines (Regulation 8(3))

In 2013 the QR99 ACOP was revised as a second edition (HSE, 2013) to incorporate the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR). Reportable dangerous occurrences include:

(a) any event (including any movement or fire) which indicates that a tip is, or is likely to become, insecure;

(b) any movement or failure of a slope or face which has the potential to cause the death of any person or to adversely affect any building, contiguous land, transport system, footpath, public utility or service, watercourse, reservoir or area of public access.

Unfortunately the term insecure as used in (a) above is not defined. The wording as stated without appropriate definition would indicate that any tip that could fail would be reportable under RIDDOR. Whereas the consequence of failure and so risk of a dangerous occurrence should be considered. There are a significant number of tips in the UK which whilst they could fail pose no risk being that they are appropriately isolated within a quarry or mine boundary. Recent work for, and with the support of, the Geotechnical Subcommittee of the Quarries National Joint Advisory Committee, has developed some draft wording to help clarify design meanings (Clifford, 2023). Its work in progress definitions are shown in Table 3.

Table 3. Draft Definitions for Design & Assessment of Excavations & Tips (after Clifford, 2023)

SAFE	Where the current state of an E&T does not, in the opinion of a competent person, pose a danger to any person, the environment, or property.
SECURE	Where the future state of an E&T is, in the opinion of a competent person, stable.
UNSTABLE	Where the current or future state of an E&T has, in the opinion of a competent person, deformed more than the expected design allowance.
INSECURE	Where the future state of an E&T, in the opinion of a competent person, is or is likely to become unstable and pose a danger to people, the environment, or property.
SIGNIFICANT CHANGE	A change to the situation, condition, operation, loading or entry that has a material impact on the safety or security of an E&T.
SITUATION	Being the location, geometry and environs of an E&T.
CONDITION	Being the physical, biological and chemical properties of an E&T.
LOADING	Being any man-made or natural force acting on an E&T.
ENTRY	Being the ability for a person, machinery, water or wildlife to enter an E&T.
FUTURE	Reasonably foreseeable within the design life of an E&T.
COMPETENT PERSON	For an E&T that is a Significant Hazard, being a Geotechnical Specialist as defined in QR99. For an E&T that is not a Significant Hazard, being a suitably qualified person (eg EQF Level 3 or 4 Geotechnical Award or equivalent) with the necessary experience and other qualities.

Note: E&T is Excavation and/or Tip as defined by the Quarries Regulations 1999 / Mines Regulations 2014 .

The aforementioned distinction between excavations and tips at mines from those at quarries was consolidated by the subsequent arrival of the Mines Regulations 2014 (MR14). The HSE website (source https://www.hse.gov.uk/pubns/books/l149.htm) summarises the changes relevant to excavations and tips design:

- The large volume of prescriptive law was replaced by a single, modern set of regulations containing goal-setting requirements that focus on the control of the risks from major hazards in mines.
- The principal duty holder became the mine operator, not the mine manager (akin to QR99).
- Competence is a clear requirement for all people working in a mine.

It was reported that during the MR14 consultation, mine operators expressed a liking for the increased flexibility, reflection of current working practices and welcomed the change to risk-based provisions from prescriptive measures (HSE, 2014).

MR14 guidance (HSE, 2015) states that the mine operator should have:

- an effective safety management system (SMS) to address all significant risks and provide control measures for major mining hazards at the mine, to include
- a competency management system (CMS) and
- appropriate safety performance indicators (SPIs).

It also noted that National Occupational Standards (NOS) in mining had been developed for a range of posts in consultation with the mining industry, to form the basis for training and competency assessment.

In Part 3 'Control of major hazards', Regulation 32 (duty to take ground control measures) provides for assessment of risks from ground movement but no specific reference to geotechnical specialist. Details of what should be included in an assessment of ground conditions or any significant change, including design document and details and geotechnical specialist's report, are confined to the extensive guidance notes. Schedule 1 carries forward coal mine support system standards from The Mines (Control of Ground Movement) Regulations 1999.

In MR14, a notable difference from QR99 is that geotechnical specialist is only defined under provisions for tips (Table 4). This a little at odds with ground movement (sf. excavations) being classed as a major hazard in MR14 Part 3, whereas tips are treated separately in Part 8 (Regulations 60-67 with guidance notes and definition of significant hazard). The latter include the appraisal (Regulation 61) and geotechnical assessment (Regulation 62) of tips, akin to regulations 32 and 33 for excavations and tips in QR99. MR14 Schedule 2 specifies the content of geotechnical assessments but differs from QR99 Schedule I in that it relates only to tips.

Table 4. Definitions of Geotechnical Specialist at Mines and Quarries

Regulations	Definition
Quarries Regulations 1999 (Regulation 2)	a chartered engineer or chartered geologist who has (a) three or more years relevant experience in soil mechanics, rock mechanics or excavation engineering; and (b) is competent to perform a geotechnical analysis to determine the hazard and risk arising from the excavation or tip being assessed.
Mines Regulations 2014 (Regulation 62)	A person who is suitably qualified and competent to perform a geotechnical analysis to determine the hazard and risk arising from the tip being assessed.

This was an apparent change of emphasis about geotechnical specialists in MR14 and a more generalised approach to their qualifications and experience i.e. no specific professional qualification listed (C Eng or C Geol).

The HM Mines Inspectorate later published the Major Hazard Topic Inspection Guide for Ground Control at Mines (HSE, 2018a). Whilst this was mainly for the use of inspectors and interventions, it contained a useful performance scoring matrix for operators' compliance with statutory provisions for ground control.

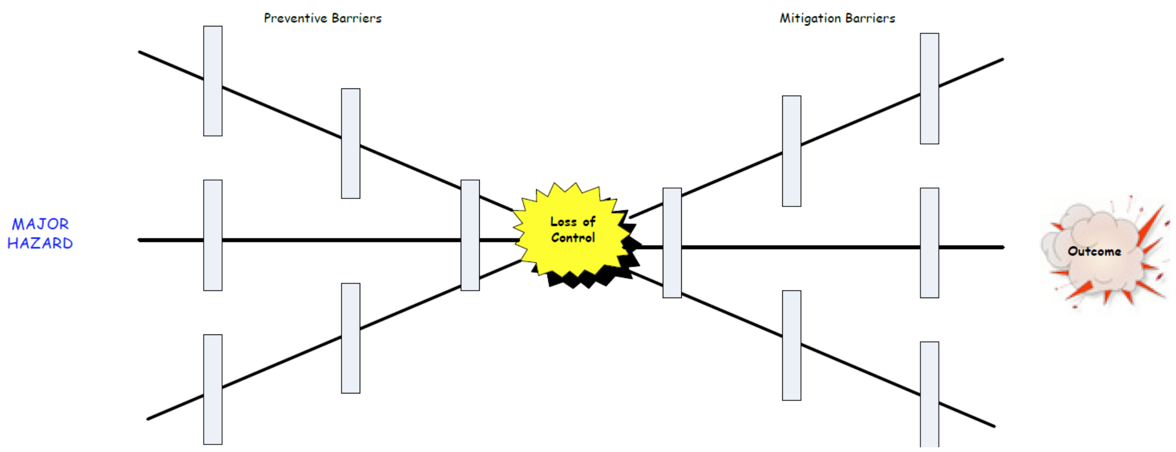

Figure 2. Bow-tie model of layers of protection (HSE, 2018b)

In the same year, a Major Hazard Regulatory Model was published for safety management systems in a goal-setting framework where duty holders determine their own multi-layered control measures for major hazard risks (HSE, 2018b). The bow-tie model (Figure 2) can be applied to excavations and tips, from hazard identification through to effective risk control, using a set of barriers (or risk control systems).

Since the turn of this century, requirements to consider the hazards, risks and consequences of failure of excavations and tips have appeared in other legislation. Not all operators and practitioners who design or manage excavations and tips in mines and quarries may be as familiar with such provisions as they are with the aforementioned statutes. Therefore, some salient points are provided in the following sections to help practitioners effectively execute their duties.

National Planning Policy

The English National Planning Policy Framework (NPPF) 2012, revised in 2024, mandates that all new planning applications and permissions must include consideration of land stability; with similar provisions provided in policy for Wales and Scotland. The NPPF applies to all new mineral consents as part of the planning process. As a result, geotechnical design aspects should be addressed during the application stage, especially concerning excavations and tips. Specifically, the following requirements from the NPPF must be taken into account:

- Planning policies and decisions should contribute to and enhance the natural and local environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.
- Planning policies and decisions should ensure that a site is suitable for its proposed use, taking account of ground conditions and any risks arising from land instability.
- Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.
- A competent person is to prepare site investigation information*, who has recognised relevant qualifications, sufficient experience in dealing with land instability, and membership of a relevant professional organisation. [* includes ground stability and slope stability reports, as appropriate].
- Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities. Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development in its vicinity, the applicant (or 'Agent of Change') should be required to provide suitable mitigation before the development has been completed.

The NPPF Agent of Change principle effectively requires quarry and mine operators to consider and mitigate the effects of excavation and tips on existing businesses and community facilities.

The Control of Major Accident Hazard (COMAH) Regulations 2015

The Control of Major Accident Hazards (COMAH) Regulations ensure that businesses take all necessary measures to prevent major accidents involving dangerous substances and to limit the consequences for people and the environment if such accidents occur. While COMAH applies to industrial establishments that store or use dangerous substances above specified threshold quantities, it also provides useful guidance for the development of a Safety Management System (SMS) that can be adapted for major accidents related to Significant Hazards. Significant Hazards include excavation and tips that are of sufficient size or hazard to be notifiable.

A good SMS for the control of Significant Hazards must demonstrate commitment from senior management and should ideally consider the following:

- Risk identification and assessment
- Operational control procedures
- Training and competence of staff
- Maintenance and inspection
- Management of change procedures
- Incident reporting and investigation
- Performance monitoring and audits

The SMS should also include both on-site and off-site emergency plans. Mines and quarries should have emergency plans in place, so developing a separate emergency plan for excavation and tips would be inappropriate. However, existing emergency plans should be tested for their suitability in managing a major incident involving the failure of an excavation or tip. The operator should consider how the emergency plan addresses the following in the event of such a failure:

- Emergency procedures
- Evacuation plans
- Communication systems
- Containment measures
- Coordination with emergency services

Mining Waste Directive 2006/21/EC

In addition to existing legislative controls governing mine and quarry tips, the Mining Waste Directive 2006/21/EC introduces a further regulatory framework for the management of extractive waste. It classifies such tips as mine waste facilities, a system implemented in the UK through the Environmental Permitting (England and Wales) Regulations 2016, alongside equivalent provisions in Scotland and Northern Ireland.

Under these regulations, mine and quarry waste facilities are categorised according to the level of risk they pose to the environment and public safety:

- Category A facilities represent high-risk sites with the potential for major accidents, such as large tailings dams containing hazardous waste.
- Category 2 facilities are considered to pose a moderate risk and typically include large, non-hazardous waste tips.
- Category 3 facilities are low-risk sites, generally comprising small volumes of inert rock waste.
- Exempt - inert materials extracted and deposited within the same site under specified conditions.

All categories require a formal assessment addressing key factors, including slope stability, erosion and drainage, dust generation, surface water runoff, and restoration design.

Category A facilities are subject to the most stringent regulatory controls due to their potential to cause significant harm in the event of failure, the presence of hazardous waste, or the inclusion of dangerous substances above defined thresholds. These facilities must operate under an Environmental Permit and are required to undertake a stability risk assessment, implement a Major Accident Prevention Policy (MAPP), establish both on-site and off-site emergency plans, maintain detailed monitoring and safety reporting systems, and adopt a Construction Quality Assurance Plan.

In addition, Category A facilities must comply with the Major Accident Off-Site Emergency Plan (Management of Waste from Extractive Industries) (England and Wales) Regulations 2009. These regulations require operators to develop comprehensive procedures for accident prevention, response, and recovery, and to provide relevant information to local authorities to facilitate the preparation of off-site emergency plans. The MAPP must be overseen by a designated safety manager and should incorporate structured processes for auditing, monitoring, reporting, and reviewing operational practices, including those relating to tipping procedures and the stability of waste deposits such as lagoons and retaining structures.

Category 2 facilities, while not presenting a major accident hazard, may still pose environmental risks, for example, through contaminated drainage. These facilities typically require an environmental permit, although the regulatory controls are less stringent than those applied to Category A. Permit conditions generally address pollution control, water management, and monitoring and closure requirements. A stability risk assessment and Construction Quality Assurance Plan are also required.

Category 3 facilities represent low-risk operations, typically involving inert waste such as small spoil heaps or low-risk quarry materials. While these facilities may still require environmental permits, simplified or exempt permitting regimes may apply depending on the nature of the activity and materials involved. Notwithstanding reduced requirements, such facilities remain subject to regulatory oversight under environmental permitting legislation.

Exempt facilities generally involve inert extractive waste, including materials such as soil, stone, sand, limestone, and granite, which are generated, stored, and utilised within the same mine or quarry as part of routine operations. Typical uses include overburden storage, screening rejects, temporary stockpiling, and backfilling. Where such activities do not pose pollution risks, an environmental permit is usually not required. Instead, these operations are controlled through planning permission and existing mine and quarry legislation.

NEW REGULATIONS FOR DISUSED TIPS IN WALES

Meanwhile, the law relating to disused tips had remained essentially unchanged for over 50 years since the 1969 Act. Over those decades and with the decline of UK coal and other mining, the number of disused tips relative to active or closed tips (at mine/quarry sites) became disproportionately greater. Notwithstanding the establishment of the Coal Authority (now Mining Remediation Authority) by way of the Coal Industry Act 1994, the level of risk to the public has increased with time, along with the transfer of responsibility to local authorities, or so it could be argued.

Ultimately, on 24th March 2022, The Law Commission of England and Wales published a report ‘Regulating Coal Tip Safety in Wales’. It recommended a new coal tip safety regime in Wales that would replace “outdated laws” and improve management of risks with disused coal tips. It recommended:

- Single supervisory authority for disused tips – new rather than existing responsible authorities such as the Coal Authority and councils;
- A tips register - compiled and maintained by the said authority; and,
- Tip inspections, risk assessments, management plans and risk classifications for disused tips.

On 9 December 2024 the Welsh Government introduced The Disused Mine and Quarry Tips (Wales) Bill. Arguably described as the first of its type in the UK, it proposed to establish a Disused Tips Authority for Wales to manage disused coal and non-coal tips. The Bill went through Stage 1 consultations and oral evidence sessions with representatives from the Health and Safety Executive (HSE), local authorities (some being disused tip owners) and the mining and quarrying sector. Stage 2 and Stage 3 comprised amendments before the Bill reached Stage 4 approval in the Senedd on 15 July 2025. It then became law in Wales as The Disused Mine and Quarry Tips (Wales) Act 2025 via Royal Assent on 11 September 2025. The new Act has been published by the National Archives and can be accessed on the Welsh Government’s Law Wales website.

In essence, the new Act will replace Part II of the Mines and Quarries (Tips) Act 1969, but only in Wales. There are provisions included for both Acts to cover a small number of disused tips that straddle the border between England and Wales. However, the new Act does not apply to tips covered by the Quarries Regulations 1999 or the Mines Regulations 2014.

The Disused Tips Authority for Wales will be established on 1 April 2027 at the Welsh Government office at Rhyd Y Car, Merthyr Tydfil.

THE CONCEPT OF DESIGN FOR EXCAVATIONS AND TIPS

As outlined above, the concept of design for excavations and tips in the modern day mine and quarry environment has taken considerable time to evolve from a historical construction-focused approach. However, since the turn of this century, it has been applied more critically in both regulation and practice.

There is an opportunity to advance this further by considering the design steps defined in other regulations and standards common in other sectors. Several common design approaches have been discussed in the following section, which should serve as an aid to practitioners when considering established best practice.

The Construction (Design & Management) Regulations (CDM 2015)

The strength of the CDM 2015 regulations is the way they set out how to manage a construction project, which may have parallels to higher risk excavations and tips in mines and quarries. CDM 2015 requires the formal appointment of duty holders, including the Client, Principal Designer and Principal Contractor; perhaps akin to the site owner, geotechnical specialist and operations manager. The Principal Designer is responsible for planning, managing, monitoring and coordinating health and safety in the pre-construction phase of a project. This includes identifying, eliminating or controlling foreseeable risks and would therefore align well with the goal-setting Mines Regulations 2014 that focus on the control of the risks from major hazards in mines.

For larger, complex mine or quarry excavations and tips a competent person in that role would bring together members of the design team i.e. mining engineers, geologists and geotechnical engineers with operations management to ensure the relevant H&S aspects are considered and appropriate design risk assessments are undertaken. Some mine and quarry operators conduct annual Quarry / Mine Design Plan meetings between design and operations teams. These meetings focus on sharing information and site feedback to help optimise the design. A Technical Queries system, typically used in the construction industry, could be applied to communicate and resolve design uncertainties or change between the designer and operator. Setting goals based on this structure would fit within a Safety Management System, enabling actual compliance with individual design parameters and providing a set of quantifiable, measurable Safety Performance Indicators.

The general application of CDM 2015, rather than the current mines or quarries regulations at a mine or quarry, would, in the opinion of the authors, be a significant step backwards, given that CDM is a broad framework implemented to control construction work. Due to the breadth (and so the limitations) of CDM, it does not include in-depth controls for activities such as earthworks. As such it is recommended that, when CDM is implemented, best practice be sourced from the relevant mines and quarries legislation, codes of practice, and standards. As such, even if an area of a mine or quarry is demarcated out for CDM, this does not preclude the requirement to follow such practices.

Eurocode 7: Geotechnical Design

Current quarries and mines regulations require designs to be undertaken for excavations and tips. In the UK the relevant design standard is Eurocode 7: Geotechnical Design as the former British Standards have been withdrawn. Eurocode 7 sets out to achieve two critical practices:

1. Improve the design method by using partial factors of safety; design values for each part of a calculation such as slope stability analysis and as such remove a generalised factor of safety.
2. Set out clearly the design process and its reporting in a common language.

The Eurocode allows the designer much greater freedom to apply appropriate safety margins to each part of the design/parameter. Whilst enabling the designer to better optimise the design, the code forces the designer to then fully consider and report their justification for their design. In 2025, Eurocode 7 was updated to improve ease of use and to explicitly include rock mechanics, so addressing soil and rock ground conditions equally. The update also addresses dynamic and cyclic loading, which is especially pertinent to operations involving blasting.

The requirements of Eurocode can be integrated into a Safety Management System (SMS) and Safety Performance Indicators (SPIs) created by scoring the confidence and evidence for the justification of the design parameters. Too often assumed, estimated or published values are used in geotechnical assessments, which can cause poor optimisation of the design. Integrating design practices within a SMS and SPIs would focus the designer and operator to consider the value to be placed on each parameter to improve existing and proposed designs. Reporting to Eurocode 7 should also enable easier transition between design teams as a common approach and language is required.

Reservoirs Act 1975 & Engineering Roles

The Reservoirs Act 1975 provides the legal framework for ensuring reservoir safety. Reservoir safety means prevention of flooding from an uncontrolled escape of water (failure) and reduction of the risk of dam or reservoir failure. The act covers any large raised reservoir (LRR) outside of a mine or quarry, where the volume of water held above the surrounding land is 25,000 cubic metres or more. The act brought in specific engineering roles to be appointed by the undertaker for reservoir safety:

- Construction engineer – to supervise design and construction during build, repair or modification stages of a reservoir.
- Inspecting engineer - to inspect a reservoir, report their findings and make recommendations to improve safety or maintenance measures; they must inspect high risk reservoirs every 10 years (or

more frequently if necessary). In their role as a QCE, they supervise and certify that the measures have been acted upon.
- Supervising engineer - to supervise the operation and maintenance of a reservoir and prepare a written statement at least every 12 months. This statement must summarise the activities carried out to fulfil the inspecting engineer's recommendations and highlight any shortcomings.
- All panel engineer - reservoir engineers who can undertake the duties of any of the above roles.

Whilst mine and quarry excavations and tips regulations have many requirements, it must be considered whether such clear roles exist in practice in design teams. For example: do geotechnical specialists undertake their own design checks or consult another engineer to inspect and supervise works?; do they list out which design activities require such checks and to what level?; should part of the SMS and so SPIs set out in the design process the appropriate level of checks and competencies and acceptable degree of independence required for such checks?

ADVANCES IN TECHNOLOGY RELATED TO EXCAVATIONS AND TIPS DESIGN

The pattern of technology deployment in excavations and tips design has followed that of regulation, one of progression. However, the variety and pace of change has been markedly different, mainly because many technology developments have been learned or adapted from other sectors such as civil engineering, construction and spatial engineering, whereas the legislation itself has not had an equivalent level of external influence.

At the time of the 1954 Act, design technology would have been rudimentary with limited use, given the lack of reference to design at that time. With the 1969 Act came the onset of geotechnical engineering approaches to excavations and tips, but typically in 2D paper format and manual calculation/assessment.

The Mines and Quarries (Tips) Regulations 1971 prompted tips and excavations to become more design-led with dedicated geotechnical engineers and geologists employed by operators. Although rock and soil mechanics were well established subjects, paper-based and manual methods of data collection and interpretation, stability analysis and stereo net plots were still the norm. Data availability was a limiting factor, reliant on total station surveying and little expenditure made on site investigations and laboratory testing for geotechnical design purposes. Sophisticated mine design and modelling packages being developed by software houses such as Datamine and Maptek were generally adopted and more affordable by large mine operators outside of the UK.

The two current UK regulations relevant to excavations and tips in mines and quarries have been in force since 2000 and 2015. Technology has flourished in those decades, as both a response and an inevitability. Laser scanning and face profiling, satellite INSAR, drone and photogrammetric surveys have all enabled better geotechnical analysis, and tips, excavations and explosives/blast design. Groundwater and rock/soil properties can now be monitored continuously, in real time and digitally processed and reported on site. At least one UK operator has trialed the use of a mobile device app to enable inspections and geotechnical appraisals to be conducted and reported almost instantaneously. Underground excavations can be measured and monitored in detail with mobile laser scanners, small UAVs and submersibles. Eurocode 7 methods have been built into slope stability software (e.g. Rocscience Slide). Mine and quarry design software packages now offer a holistic approach to design, with integrated 3D modelling, mine design and geotechnical assessment modules. Relevant to disused tips, studies have been undertaken to evaluate landslip susceptibility in Wales with a risk-based assessment tool that uses soil moisture data from satellites (Central Alliance, 2024).

Coupled with the above, training and assessment have reached new standards to attain the necessary competence in their use and application. For example, the Mineral Products Qualifications Council (MPQC) geotechnical training levels.

THE FUTURE OF EXCAVATIONS AND TIPS DESIGN AND PERFORMANCE

Safety management systems (SMS) are not new in UK quarries and mines. The introduction of safety performance indicators (SPIs) in MR14 has so far provided more than ten years' worth of opportunity to develop them and put them into practice in mines.

Areas where these might be more widely adopted to create SPIs for design and construction compliance in excavations and tips in mines and quarries, facilitated by aforementioned technologies, include:

- excavation or tip geometry actual versus predicted (e.g. assessment of percentage variations, hence risk)
- condition monitoring of quarry haul roads and roof, sides and floors of roads in underground mines
- AI data gathering and interrogation

The MR14 approach to geotechnical specialists places a greater onus on the operator and its Competence Management System to be able to select or appoint such a specialist with the requisite competence. However, it seems inappropriate for an operator to determine a specialist's competency when it is unlikely to be their own field. Based on QR99 The Quarries National Joint Advisory Committee (QNJAC) has published guidelines on the selection of a geotechnical specialist, and endorsed by the HSE (QNJAC, 2024). As the geotechnical specialist is one of the key roles in excavation and tip design, there would be some merit in more frequent cross-consultation between mine and quarry operators and inspectors. This has already been facilitated by the HSE with the appointment of a single HM Chief Inspector of Mines and Quarries, superseding the previous two separate roles.

The Mining Association of the UK (MAUK) publication: Mining Industry Leadership Group Sector Strategy Leading the Way in Responsible Mining (2023-2028) calls for a more collaborative, multidisciplinary approach to mining standards (MAUK, 2023). This could be used to set a blueprint for excavation and tip design in both mines and quarries.

The Strategy document also stated that the nature and remoteness of UK mine operations means that apart from tip operations, there is little potential for off-site impact. However, cognisance must be made of the future direction of some UK mining/quarrying and competing activities. For example, polyhalite will be more extensively mined under the sea; lithium brine pumping will be carried out for the first time; and some quarries might be adapted to become large water storage reservoirs for public consumption. These will be coupled with the current projections for widespread energy infrastructure, onshore and offshore, and extensive housing development that could in time encroach closer towards mines and quarries or areas safeguarded for them.

Existing competency levels in engineering assessments and construction activities could be leveraged to excavations and tips in mines and quarries. The current one size fits all approach in QR99 doesn't offer flexibility to manage the input or grade of a designer. Consequently, the QNJAC Geotechnical Subcommittee has mooted the idea of a UK Register of Quarry Geotechnical Specialists. MAUK provides Competence Training Programmes, accredited by the MPQC. Two of the training courses are for roles as Mine Geotechnical Engineer and Mine Ground Control Coordinator (MAUK, 2024a-d). This is another opportunity to bring new approaches to design management and risk control under the auspices of, or in conjunction with, the geotechnical specialist.

CONCLUSIONS

It is clear that regulations for tips and excavations have diverged over the decades. QR99 and MR14, whilst both aim to improve standards, adopt different approaches, one prescriptive and the other goal setting. Moreover, this is exacerbated by the recent introduction of tips legislation in Wales for disused tips. The time is now right for these approaches to come closer together again and encourage cross fertilization of ideas and:

- introduce excavations and tips SPIs from mines into quarries, understood to be underway with guidance from the HSE
- enhance the role of the geotechnical specialist in a more consistent way between quarries and mines
- transfer knowledge from mines and quarries to existing and new authorities responsible for disused tips, which have become a progressively greater public risk.

The full spectrum of relevant technologies is far too great to consider in the scope of this paper. Suffice to say, modern day design of excavations and tips has an armory of tools available to help optimize the result, which is nothing like that when it all started with the Mines and Quarries Act 1969. This has provided a sound foundation to build in more detailed excavations and tips design into Safety Management Systems and Safety Performance Indicators in both mines and quarries, and beyond into the safety and management of disused tips.

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