ACHIEVING APPROXIMATE ORIGINAL CONTOUR IN MOUNTAIN TOP MINING

by

Michael J. Superfesky

Abstract. The definition of approximate original contour (AOC), as found in the Surface Mining Control and Reclamation Act of 1977 (SMCRA), requires that the final surface configuration of the land, after backfilling and grading, closely resemble the general surface configuration of the land prior to mining while maintaining the necessary flexibility to accommodate site specific conditions. The mining operation and the final reclaimed site must not only meet AOC standards, but also satisfy numerous other safety and environmental requirements for slope stability, access, drainage, and water pollution control. Other factors that affect final configuration are the diversity of the terrain, and climatic, biological, chemical and other physical conditions in the area along with their impact on fish, wildlife, and related environmental values. This paper describes guidelines developed jointly by the Office of Surface Mining (OSM) and the West Virginia Division of Environmental Protection (WVDEP) AOC Team to provide a rational objective approach for determination of AOC and excess spoil volumes while adhering to the regulatory and environmental requirements. This guideline is currently being tested in West Virginia by the WVDEP with technical assistance from OSM. The guideline is also being used as the basis for the AOC portion of a Federal Court settlement agreement in West Virginia.

Additional Key Words: snrface mining, backfill, excess spoil, valley fill

Introduction

Mountaintop and steep slope mining operations must be retnrned to approximate original contour (AOC) unless the permittee obtains a variance. The historic Office of Surface Mining (OSM) guidance has been that AOC is a flexible standard to be determined on a site-specific basis during the permitting process. A recent OSM oversight evaluation revealed that policies or procedures nsed for determining when a mining operation's reclamation plan satisfies requirements for AOC were either applied inconsistently or were too broad, resulting in varied interpretations of what constitutes AOC. As a resnlt of these varied interpretations, OSM and the West Virginia Division of Environmental Protection (WVDEP) jointly formed an "AOC Team" and developed an approach and guidance document to be applied and tested in West Virginia (OSM, 1999a). This guidance document provides an objective and systematic process for achieving approximate original contour (AOC) on steep-slope surface mine operations while providing a means for determining excess spoil quantities. Using this process increases the amount of mine spoil returned to the mined area (pit) and decreases the amount of mine spoil placed in excess spoil disposal sites, i.e., valley fills. This, in turn, reduces impacts to aquatic and terrestrial habitats through ensuring compliance with environmental performance standards (OSM, 1999b).

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Statutory and Regulatory Language

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) defines AOC as at Section 701(2) as: "AOC means that the surface configuration achieved by backfilling and grading of the mined areas so that the reclaimed area, including any terracing or access roads,

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closely resembles the general surface configuration of the land prior to mining and blends into and compliments the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated..."

The Federal Regulations at 30 CFR 816.102(a) (1)-(4) require that: "Disturbed areas must be backfilled and graded to achieve AOC (unless a variance from AOC is obtained). A postmining slope necessary to obtain a minimum 1.3 static safety factor, prevent slides, and minimize erosion (usually through use of terraces and 2H:1V) placement is required.

Additional regulatory requirements related to spoil handling and placement found at 30 CFR 816.102(b) state: "Spoil, except excess spoil disposed of in accordance with 816.71 through 816.74, shall be returned to the mined-out area."

30 CFR 701.5 defines excess spoil as: "Excess spoil means spoil material disposed of in a location other than the mined-out area; provided that spoil material used to achieve the approximate original contour or to blend the mined-out area with the surrounding terrain in accordance with 816.102(d) and 817.102(d) of this chapter in non-steep slope areas shall not be considered excess spoil."

For all surface coal mining operations the operator is required to minimize adverse impacts to fish, wildlife and the environment to the extent possible. 30 CFR 816.97(a) requires: "The operator shall, to the extent possible using the best technology currently available, minimize the impacts on fish, wildlife, and related environmental values and shall achieve enhancement of such resources where practicable."

The AOC Process

Backfill Volume Displaced

Approximate original contour relates to configuration and is achieved by backfilling and grading so that the reclaimed area closely resembles the general surface configuration prior to mining and blends into and complements the drainage pattern of the surrounding terrain. The word approximate allows for the inclusion of terraces and/or access roads, which are necessary to provide drainage controls, and configuration limitations for stability to ensure that a static safety factor of 1.3 is obtained. This inclusion usually results in an inability to achieve an exact replication of the premining configuration. Although the resulting AOC configuration (Figure 1), excluding the spoil disposal areas, will generally resemble the premining configuration, the final surface may be at a lesser elevation and have a shallower slope.

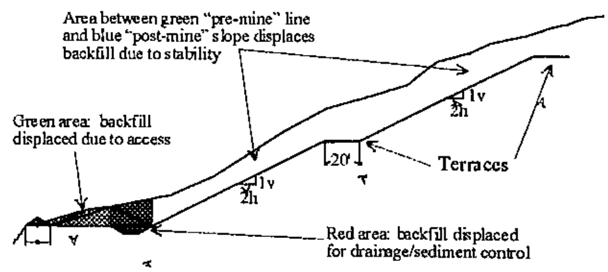
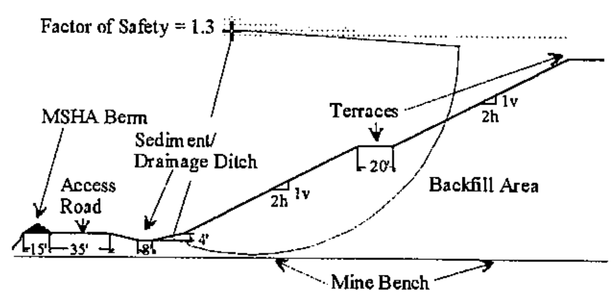


Figure 1. Details of Backfill Volume Displaced

Guidelines for achieving AOC

All highwalls and spoil piles must be eliminated.

Spoil placed on mined area must be placed in a manner that will result in a 1.3 static safety factor(SSF). A typical method of obtaining the SSF is by grading slopes to a 2H:1V ratio (Figure2).



Values, except 2h:1v slope, are for example only (e.g., width/depth)

Figure 2. Backfilled Slope Details

Drainage control may be allowed at the toe of the outslope. Erosion control measures may be incorporated by providing twenty feet wide terraces every fifty feet in vertical height.

Roads or flat areas at the toe of outslopes can be established for the purpose of providing access. Flat areas consistent with the equipment size and maneuverability can be left at the top of a backfilled ridge or hill. Only that width necessary for safety and maneuverability can be included in an AOC configuration.

A conceptual model for portraying this process could be stated as follows:

(Original Contour) - (Stability Allowance) -(Drainage Allowance) - (Access/ Maintenance Allowance) = (Approximate Original Contour)

The above expressed in terms of spoil volumes is:

$$VROC - VLSR - VLDC - VLAM = AOC$$

Where:

VROC = Volume required to achieve original contour

VLSR = Volume lost due to stability requirements

VLDC = Volume lost due to drainage controls

VLAM = Volume lost due to access and maintenance

AOC = Volume required to establish AOC

Process for establishing AOC

The process for determining the final land configuration for the permit is a structured process consisting of the following elements.

Calculate the volume of overburden to be excavated during the mining process

Determine the volume of overburden which may be placed within the perimeter of the mined area (pit) for the lowest coal seam totally removed.

Compute the volume of spoil to be placed in excess spoil disposal sites.

Develop preliminary design of the disposal sites to establish balanced volumes (Figure 3).

Develop the final design of the disposal sites by eliminating and/or combining sites and/or moving toe locations by applying AOC criteria; and,

Select the final design for the disposal sites which maximizes the volume of overburden placed in the mined-out areas and minimizes the volume of overburden places in excess spoil disposal sites.

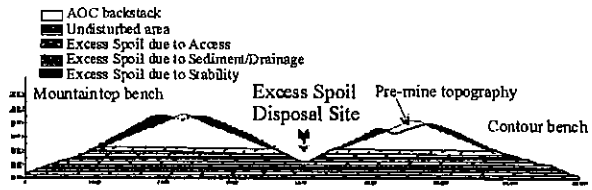


Figure 3. Excess Spoil Disposal Site

Calculate Volume of Overburden. This step consists of computing the total volume of overburden which the permittee must remove during the mining operation. This volume includes the spoil material above the lowest seam to be completely mined and the volume of material from all contour cuts below the lowest seam mined out. The volume calculated is increased by the bulk factor for the overburden material. The bulk factor is the percent increase in the bank or in-place overburden volume due to blasting and excavating minus the percent decrease caused by placement . The range for Appalachian rocks is usually 20 to 30 percent. The resulting volume is determined to be the total volume of material to be placed within the permitted area as part of the reclamation process.

As part of calculating the overburden volume, the perimeter of the lowest coal seam completely removed and the perimeter of the lowest coal seam mined are delineated on the mine maps. The perimeter of the lowest seam mined is ouly identified in those areas of coal removal by the permittee.

The delineations of these areas are used in the following steps to distinguish spoil disposal areas from mined-out areas. These delineations are needed to establish the final configuration of the land.

Compute Volume of Overburden to Backfill the Mined-out Area. The volume of overburden material needed to backfill the mined-out area is calculated as the total material needed to backfill all contour cuts plus the volume of material needed to backfill the area above the lowest coal seam mined out. The volume of material to backfill the contour areas is determined as the material needed to achieve the premining contours consistent with stability requirements. The volume of material placed above the lowest seam mined out is calculated by establishing a configuration of the backfill area using the AOC criteria described earlier. From this configuration, the volume of material needed to achieve this profile is computed using established engineering procedures for volume calculations.

The sum of all materials needed to backfill the mined-out areas is used to determine the volume of excess spoil to be placed in disposal sites.

Calculate the Volume of Excess Spoil. The volume of excess spoil is calculated as the numeric difference between the total volume of bulked overburden generated by the mining operation minus the volume of overburden needed to backfill. The initial backfill volume is calculated using the mountaintop bench as a foundation. The backfill slope of 2.4:1 is begun at a horizontal distance from the coal outcrop equal to the width needed to accommodate the SMCRA requirements of access, drainage, and sediment control. The backfill continues upward at the 2.4:1 slope to blend with the backfill from the opposite side of the mountaintop bench. However, a flatter area may be left at the crest to meet safety and machine maneuverability requirements. The difference between the total spoil volume and the initial backfill volume is the initial excess spoil volume that is used to design the excess spoil disposal sites.

Candidate spoil disposal sites are identified within the permit area in which the excess spoil will be placed for permanent disposal. The volume of spoil to be placed in each candidate disposal site is estimated based on the mining plan submitted by the permittee. These candidate sites will be used to develop the preliminary design for the excess spoil disposal sites(Figure 4).

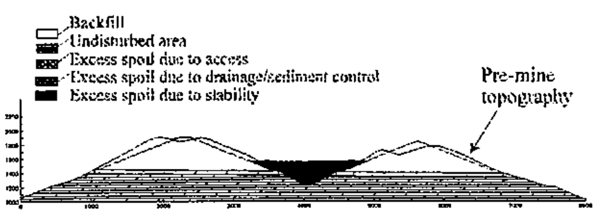


Figure 4. Fill Height Determined by Spoil Balance

Develop Preliminary Excess Spoil Disposal Structure. In each candidate disposal site, a design is developed for placement of the volume of excess spoil identified for site. The geometry of each disposal site will be determined by the physical characteristics of each area. In addition to the physical characteristics of the candidate disposal sites the preliminary design will be developed so that the footprint of the fill is minimized and the fill maintains a long term static safety factor of 1.5. A suggested starting point for this preliminary design is to establish the toe of the fill face so that the watershed above fill is equal to or less than 250 acres. This technique establishes the maximum size of the fill drainage area which may still not have to obtain an individual permit for the disposal site.

Using standard engineering processes a family of stage storage curves is created for each candidate disposal area beginning at a series of points along the valley floor. The crest elevation for the preliminary design for each valley fill is determined by the toe location and the volume of excess spoil designated for the disposal site. Obviously, for a given volume, the furthest upstream toe will yield the highest crest elevation.

The elevation established during this process along with the vertical projection of the limits of the mined out area is used to determine the starting point for final design of the spoil disposal areas(Figure 5).

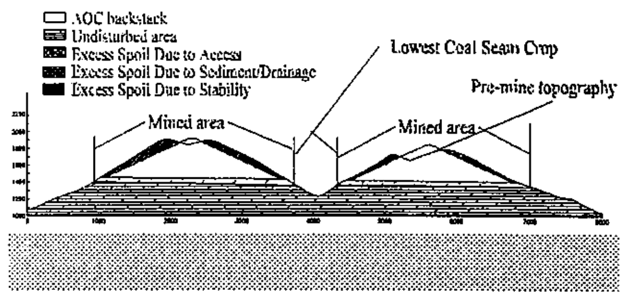


Figure 5. Lowest Coal Seam Outcrop and Mined Area

Develop Final Excess Spoil Disposal Structures. After the preliminary design for the disposal areas is completed, the final design for the area is developed by applying the AOC criteria to an additional volume of overburden material placed on top of the preliminary design (Figure 6). This process is applied using the following technique.

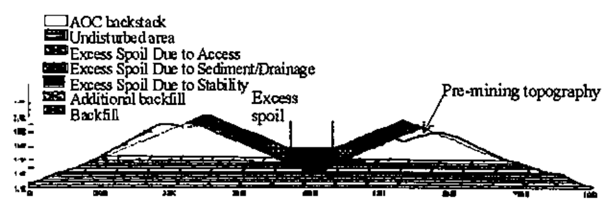


Figure 6. Delineation of Backfill and Excess Spoil

From the line formed by the intersection of the top surface of the proposed disposal structure and the vertical projection of the perimeter of the mined-out area(lowest coal seam mined within the fill area) additional overburden is placed. The configuration of this additional overburden is established by applying the AOC criteria to the additional material. The source for the additional overburden material is from or by combining other proposed disposal sites and/or moving the toe location of existing valley fills(Figure 7).

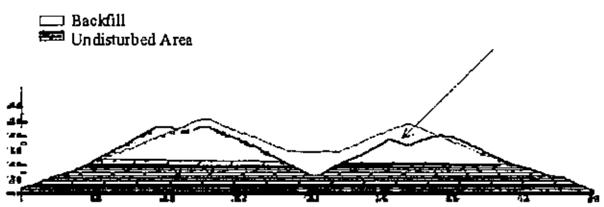


Figure 7. Final Configuration with Added Backfill

Minimizing the volume of overburden placed in the disposal sites and constructing the sites in areas as high in the valley as practicable consistent with stability requirements assists in meeting the regulatory requirements of Section 30CFR 816.97(a) to minimize impacts on fish, wildlife and related values. Figure 8 is an example of how the AOC process could affect fill length.

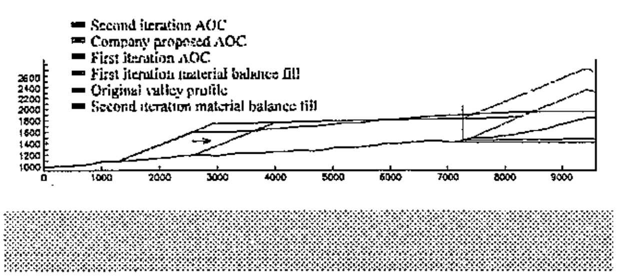


Figure 8. How AOC Process Affects Fill Length

<u>Contour Mining Operations</u>

Contour mining excavates only part of the mountainside, leaving undisturbed areas above and below the excavation (Figure 9). The mining phase of a contour mine creates a cliff-like highwall and shelf-like bench on the hillside that must be restored to approximate original contour, with the highwall completely eliminated, in the reclamation phase. For example, a contour mine typically takes one (1) contour "cut" and progresses around the coal outcrop, leaving a highwall and bench after the coal is removed.

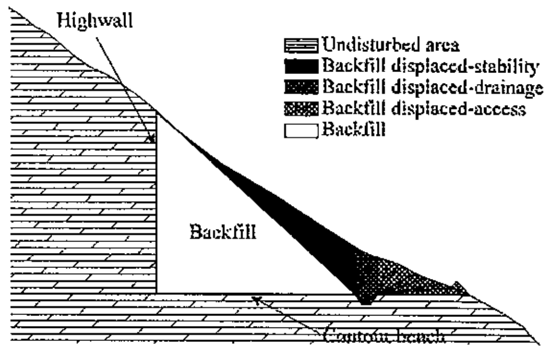


Figure 9. Typical Contour Mine Backfill X-Section

Reclaiming the site, utilizing the AOC process, would require documentation showing drainage structure desigus, access road requirements, and properly designed sediment structures. The application would also require documentation demonstrating the stability of the outslope of the material placed in the backfill area. Regulations require that slopes be designed to prevent landslides and achieve a minimum long-term static safety factor of 1.3. A generally acceptable practice, unless it results in a static safety factor of less than 1.3, includes grading the backfill slopes (between terraces where required) on a 2 horizontal to a 1 vertical ratio (2H:1V) If compliance with the other performance standards, i.e., drainage, access, and sediment control, result in backfill out-slopes being steeper than 2:1, the application should contain adequate documentation that the backfill configuration meets a 1.3 static safety factor.

Oftentimes, contour mining operations encounter long, narrow ridges or points that require more than one cut to recover the coal seam(s). Although the mining phase utilizes both the contour and area mining methods when this occurs, the AOC/excess spoil determination models are used in the same way for determining AOC and excess spoil volumes. The same principles aud performance standards apply drainage, sediment control, and access requirements must be designed and documented. Also, compliance with the stability requirements for the outslopes of the backfill must be achieved and documented. However, in order to comply with these requirements and achieve AOC, the reclamation phase of these sites must integrate two perspectives when utilizing the AOC model: 1) elimination of the highwall (perpendicular to the ridge line); and, 2) returning all spoil material that is not excess spoil to the mined area(s) (the area between the highwall and the end of the ridge line). Combining the two perspectives results in a postmining configuration that closely resembles the general configuration of the ridge or point prior to mining, while still complying with the performance standards.

Continuing the AOC Process

Testing of the AOC Process defined in this paper is continuing in West Virginia via the permit review process. Public meetings have been held to explain the process and seek comments. The process is currently being used with additional provisions for a portion of the settlement of a Federal Law suit in West Virginia (Bragg v. Robertson, OSM,1999b).

OSM is continuing its review of AOC in States with mining practices similar to those in West Virginia and will consider using the approach that is being developed in the West Virginia pilot project to help resolve any problems it may discover in those states. Kentucky and Virginia have reviewed the process and are involved in the AOC process in addition to Mountaintop Mining Studies and Fill Stability Studies (OSM,1999a).

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This approach and guidance document was developed by a team of WVDEP and OSM technical personnel (AOC Team). WVDEP personnel were: Joe Ross, Dave Dancy, Jim Pierce, Ken Stollings, and Ed Wojtowicz. OSM personnel were: Mike Castle, Mike Robinson, David Lane, and Mike Superfesky.

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