Methods of Methane Drainage

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Methods of CH_4 drainage

- There is no single preferred technique of methane drainage.

- The major parameters that influence the choice of method include

  - the natural or induced permeability of the source seam(s) and associated strata
  - the reason for draining the gas
  - the method of mining (if any).

- The common methods being practiced for CH_4 drainage are

  a. **In-seam drainage**

  b. **Gob drainage by surface boreholes**

  c. **Cross-measure borehole method**

  d. **Superjacent heading method or Hirschbach method and**

  e. **Pack-cavity method.**

In-seam drainage

- In-seam drainage is successful only if permeability of coal is high.

- If the coal permeability is sufficiently high, methane flow into mine workings can be reduced significantly by pre-draining the seam to be worked.

- Using down-the-hole motors and steering mechanisms, boreholes may be drilled to lengths of 1000 m within the seam.

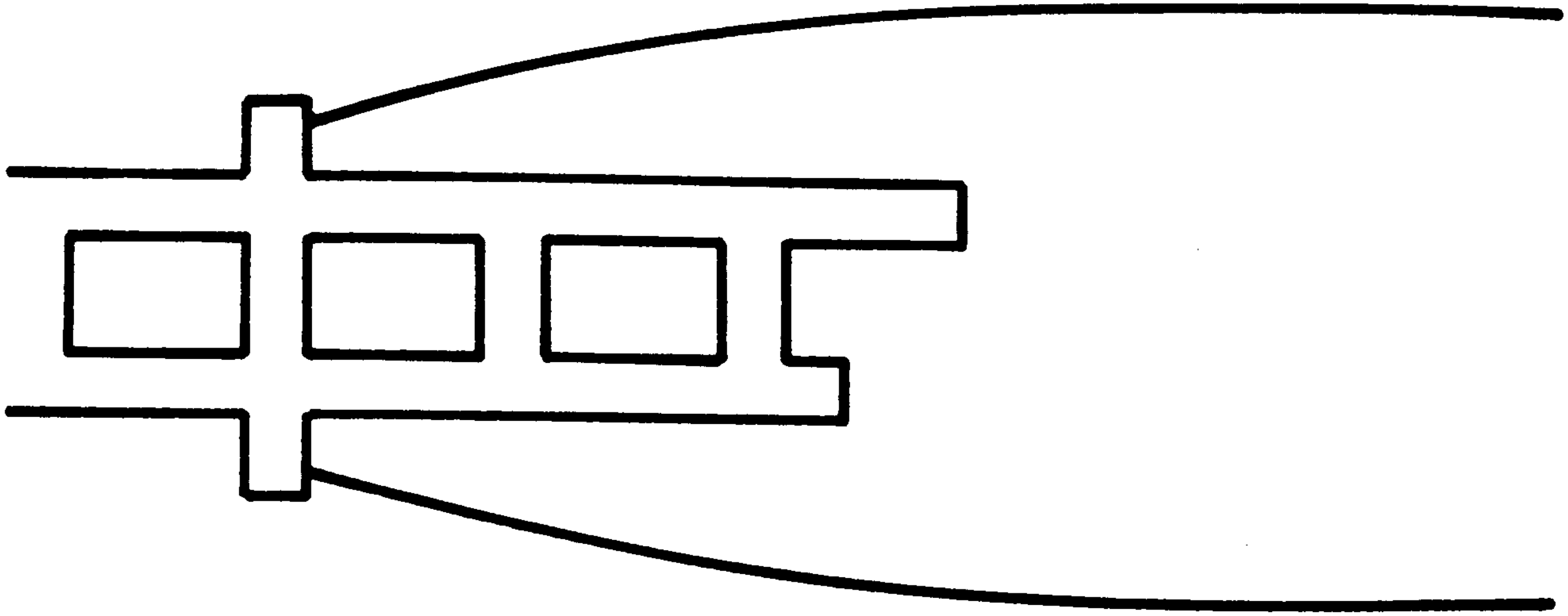
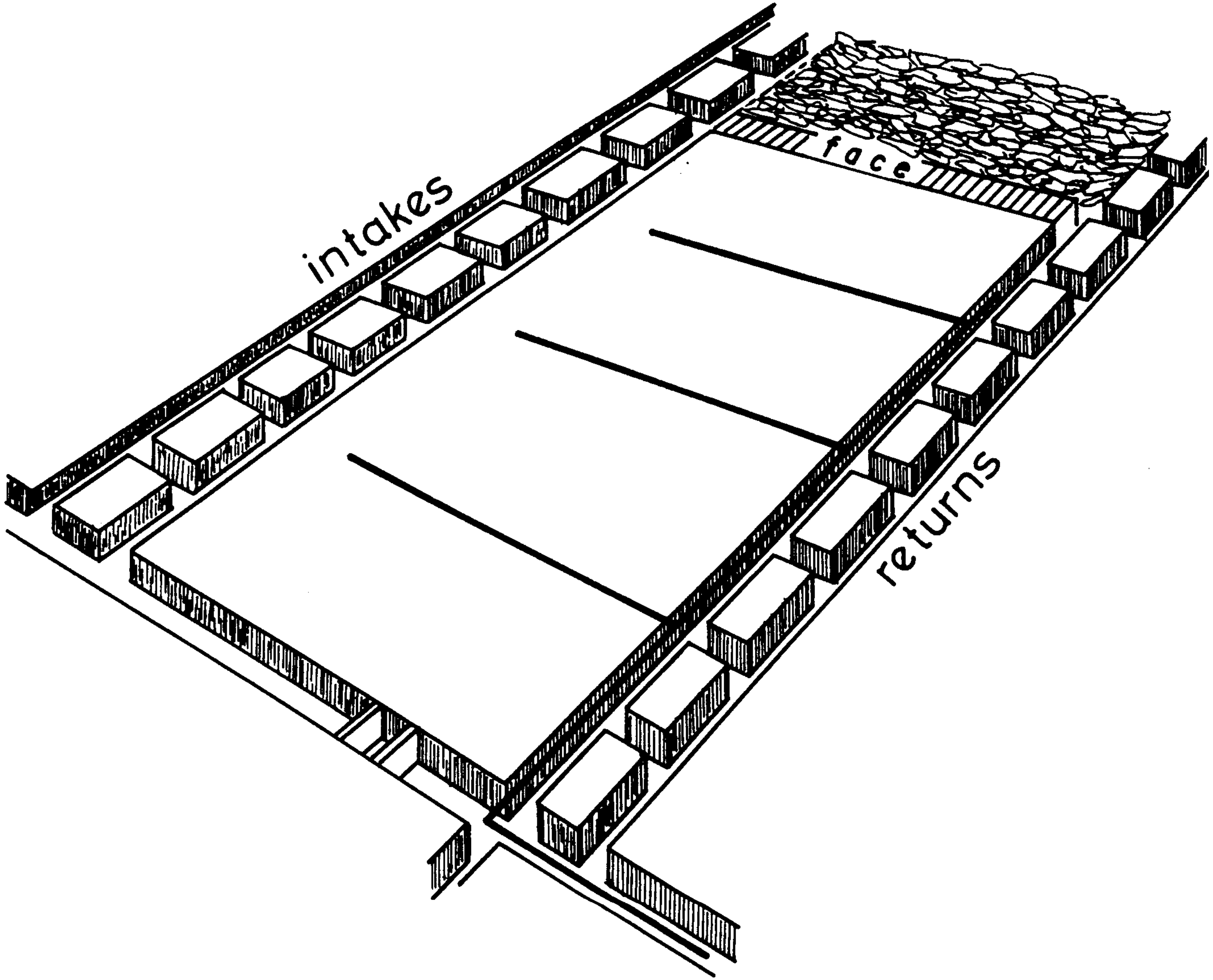


Fig. In-seam drainage boreholes to reduce methane flow into advancing headings

Flanking boreholes used to drain gas from the coal ahead of headings that are advancing into a virgin area.

In-seam gas drainage can also be effective in permeable seams that are worked by the retreating longwall systems as shown in Figure.



- Boreholes are drilled into the seam from the return airway and connected into the methane drainage pipe system.
- The preferred spacing of the holes depends upon the permeability of the seam and may vary from 10 to over 80 m.
- The distance from the end of each borehole and the opposite airway should be about half the spacing between holes.
- The application of suction on the boreholes is often unnecessary but may be required for coals of marginal permeability or to increase the zone of influence of each borehole.
- The time allowed for drainage should be at least six months and, preferably, over one year.
- Hence, the holes should be drilled during the development of the tailgate of the longwall.

- The flow rate of gas from a gas drainage borehole varies with time.

- Initially high flow occurs due to the expansion and desorption of gas in the immediate vicinity of the hole which may diminish fairly rapidly.

- As the zone of influence is dewatered, the relative permeability of the coal to gas increases and hence increases the gas flow.

- This is again followed by a decay as the zone of influence is depleted of gas.

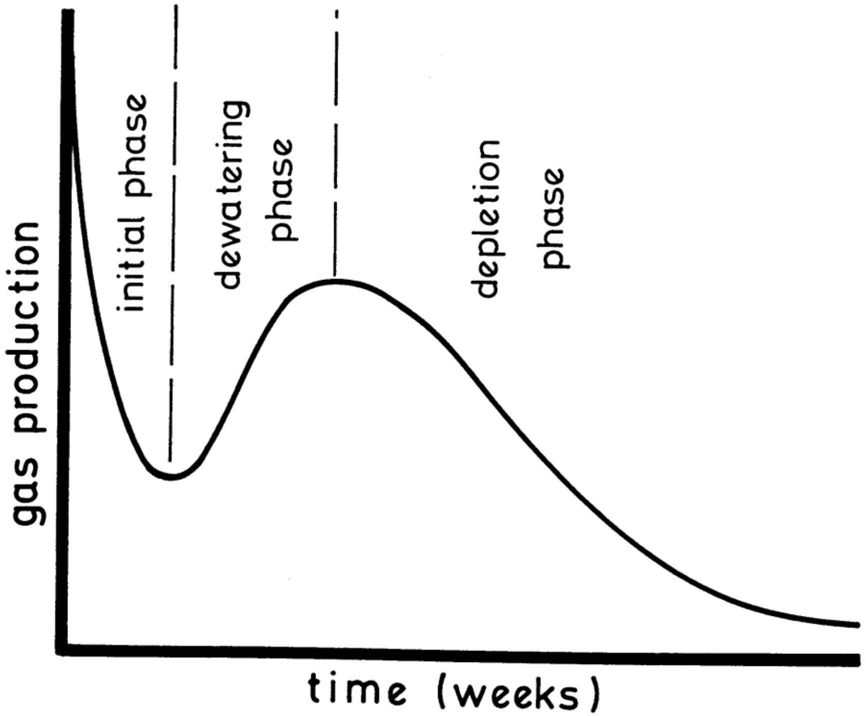


Figure: A typical life cycle of gas drainage from an in-seam borehole.

Capturing methane from Broken strata and Gob Drainage

- Because of generally low permeability of undisturbed coal seams, only a very small part of their gas content is emitted during the development stage. The gas contained in the coal seams and bands in the surrounding strata are not emitted at all.
- During extraction of the seam, relaxation of the surrounding strata takes place, often bed separation cavities form, and fracture system develops connecting the goaf with the gas emitting beds in the roof and floor.
- By methane drainage, a large part of this gas, which otherwise would get released into the workings through the goaf, is captured.

Gob drainage by surface boreholes

- Methane accumulates at high concentration in the voids or goaves of the longwall panel and called ‘gob gas’.

- If this gas is not removed, then it will migrate towards the working horizon and become a load on the ventilation system of the mine.

- Capture of this "gob gas" is accomplished underground either by cross-measures drainage or by drilling vertical boreholes from the surface.

- This is method is favoured in the United States.

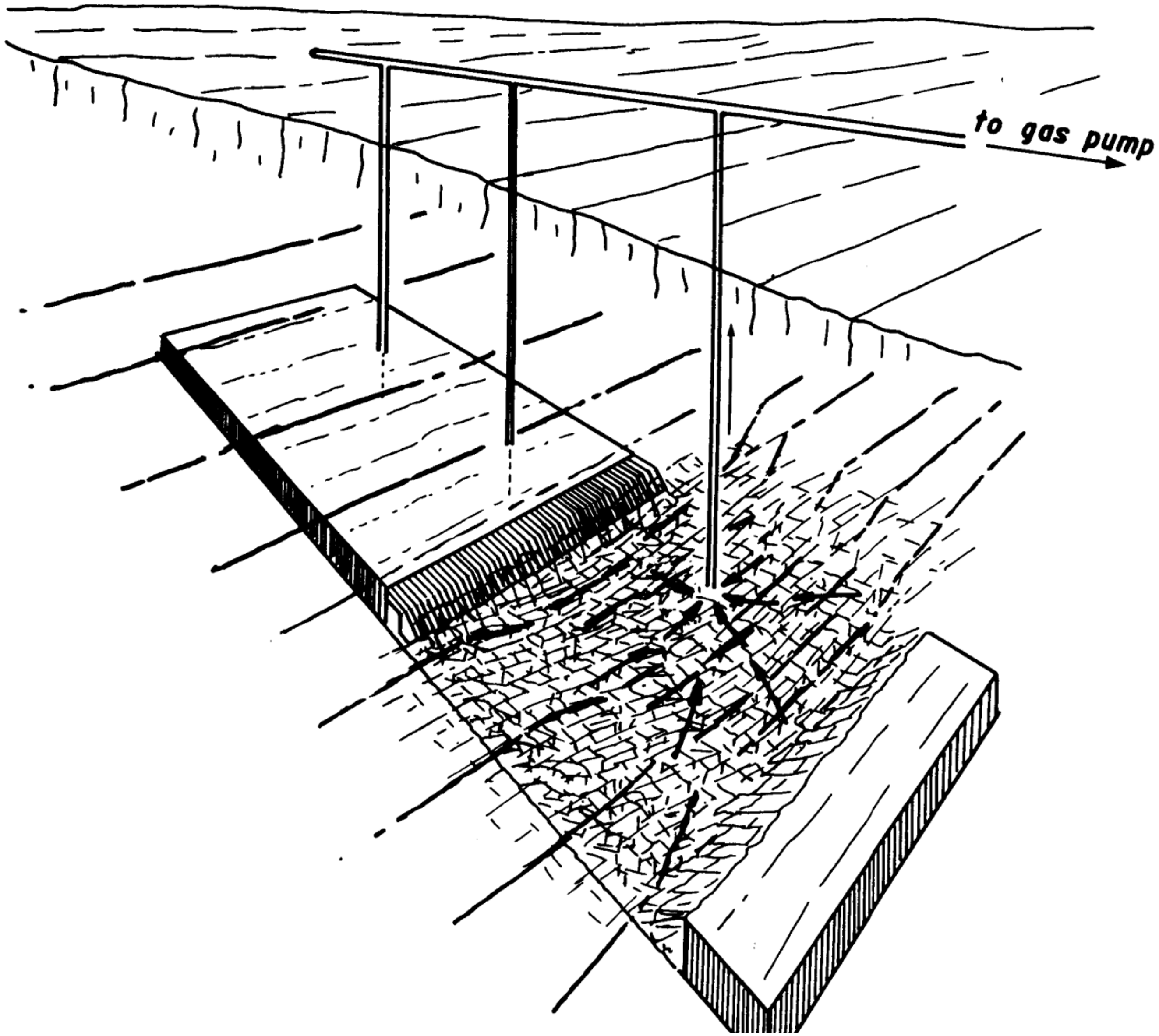


Fig. Gob drainage of a longwall panel

- Typically, three or four holes are drilled from surface rigs at intervals of 500 to 600 m along the centreline of the panel and ahead of the coal face.

- The holes may be 200 to 250 mm in diameter and drilled to within some 8 to 10 m of the top of the coal seam .

- The holes should be cased from the surface to a depth that is dictated by the local geology.

- A perforated liner can be employed in the rest of the hole to inhibit closure from lateral shear.

- The initial gas made from the surface holes is likely to be small.

- However, as the face passes under each borehole, the methane that accumulates in the caved area will be drawn towards that borehole.

- Bed separation assists drainage from the complete gob area.

- The first borehole should be located far enough from the face start line (typically about 150 m) to ensure that it connects into the caved zone.

- When a hole becomes active, the rate of gas production increases sharply and may yield over 50,000 m3/day of commercial quality methane for a period of several months, depending upon the rate of mining.

- Gas drainage pumps located on surface ensure that the gas flow remains in the correct direction and may be employed to control both the rate of flow and gas purity.

- If the applied suction is too great, then ventilating air will be drawn into the gob and may cause excessive dilution of the drained methane.

- In addition to longwall panels, gob drainage by surface boreholes can be utilized in pillar extraction areas.

- This technique can result in very significant reductions in emissions of methane into mine workings.

16.2 European Gob Degasification Methods

European coal seams are generally steeply inclined, tectonically disturbed, and seated deeper than US coal seams. Several coal seams are deposited in each basin and, typically, worked simultaneously. East European coal seams are not only gassy but also prone to instantaneous outbursts. Longwall mining system is the most common method of mining coal. Both advancing and retreating longwalls are employed in varying proportions. Most of the methane emission takes place in the gob areas following mining operations and strata movement leading to tremendous improvements in permeability.

European methane control techniques can be broadly classified in the following three groups:

1. The packed cavity method and its variants.
2. The cross-measure borehole method.
3. The superjacent method.

Each of these techniques is discussed below.

Pack-cavity method

- In this method corridors or webs parallel to the face are left in solid pack at intervals of about 40 m and within 20 m from the intake-and-return-gate roads.

- These are connected by pipes to a main pipe range in the return airway and the gas is collected by applying a suction head of 250 to 350 Pa.

- Individual pack cavities are usually connected to a main pipe range of 150 to 300 mm in dia. through pressure gauges, orifice type flow meters, water drain taps, sampling taps and valves etc.

Disadvantages:

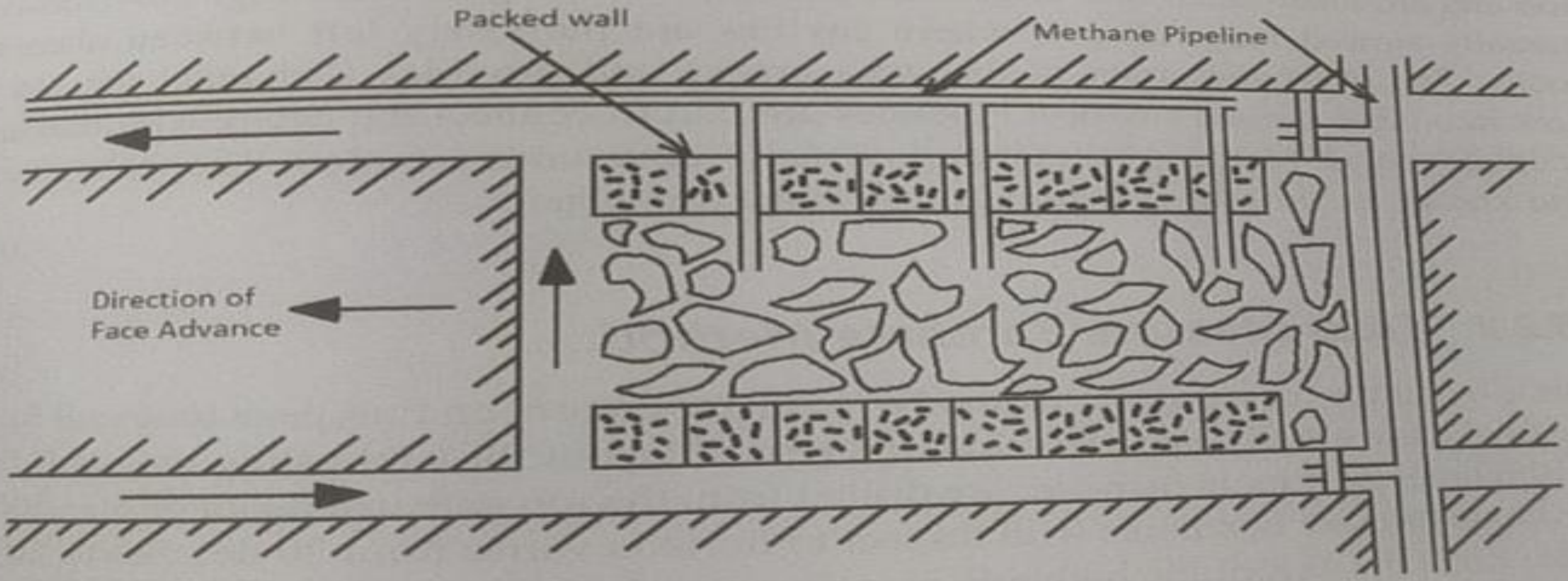
- The pack-cavity method yields minimum quantity of gas which is often much diluted.

- In this method, only a closely controlled small suction head can be applied to prevent air leakage into the goaf causing spontaneous heating as well as the dilution of gas drained.

16.2.1 Packed Cavity Method and Its Variants

Early methods of methane control consisted of simply isolating the worked out area in the mine using pack walls, partial or complete stowing, plastic sheets, or massive stoppings. A network of pipeline which passed through these isolation barriers was laid in the gob, and methane was drained using vacuum pumps. Fig. 16.3 shows typical layouts for a caving longwall face. Fig. 16.4 shows a similar layout for a partially stowed longwall face.

Lidin [3] has reviewed several variants of this technique. Methane capture ratios quoted by him are shown in Table 16.2.



igure 16.3 Packed cavity method for a caved longwall face.

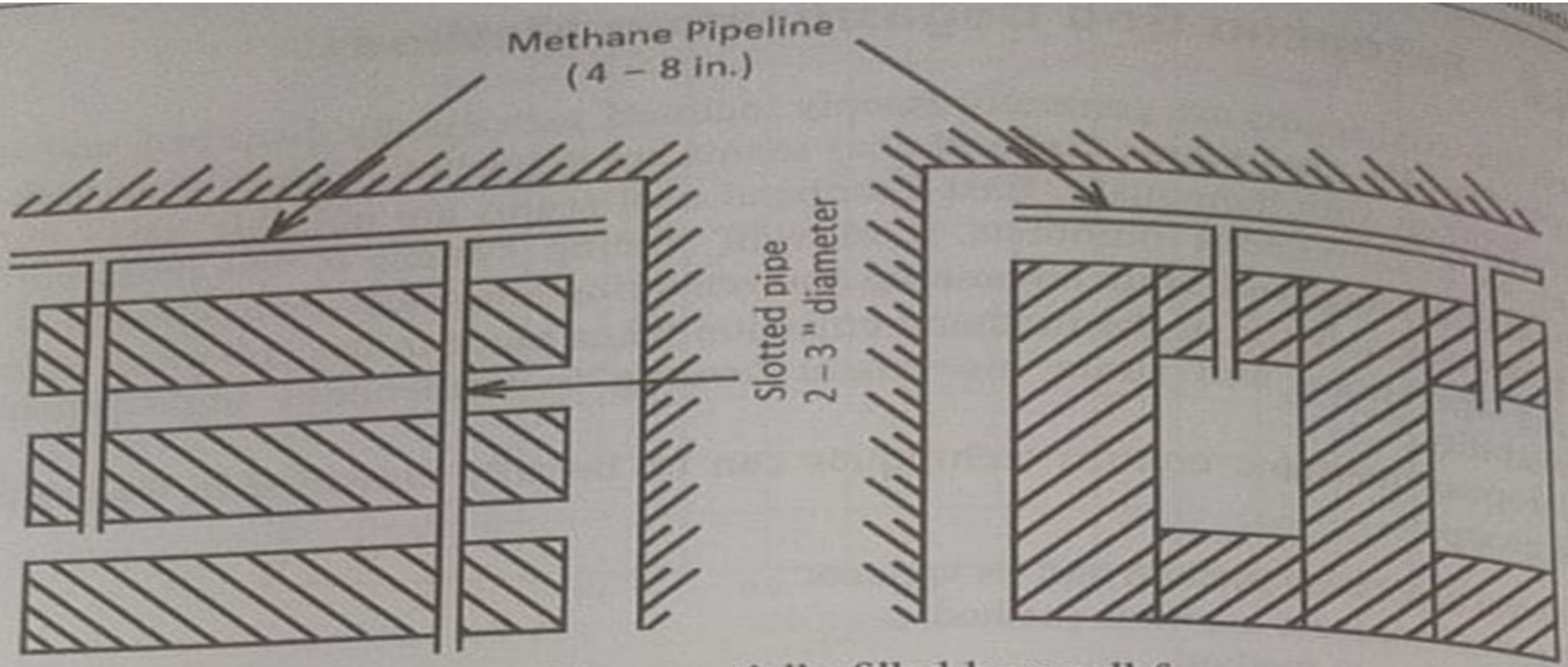


Figure 16.4 Packed cavity method for a partially filled longwall face.

Table 16.2 Methane Capture Ratios for Packed Cavity Methods

Method of Mining	Method of Gob Stowing	Methane Capture Ratio (%)
Longwall advancing	Caving	20–40
Longwall advancing	Partial filling	30–50
Room and pillar	Complete filling	60–80

The ratio generally seems to improve from caving (20%–40%) to fully stowed longwall gobs (60%–80%). The gate roads are protected by a pack wall against the gob. Pipelines are laid through the pack wall to reach nearly the centerline of the gob and are manifolded to a larger diameter pipe in the gate road. Fig. 16.4 shows a partially stowed longwall gob where cavities are purposely left between alternate packs. The overlying strata in that area cracks and provides a channel for gas to flow into these packed cavities. Pipelines are laid to connect the cavity with methane drainage mains. Methane extraction is usually done under suction. The technique is also known as "Roschen" method of methane drainage.

Cross-measure borehole method

- It is the most common method used for methane drainage.
- Cross-measure boreholes are drilled from roadways (usually tail gate of an advancing longwall face) either upwards or downwards in a working seam.
- Upward boreholes are more common because methane usually accumulates in the bed-separation cavities in the roof of the seam and is driven out of these cavities as the roof breaks and collapse.
- The holes are inclined depending on the dip of the strata.
- In flat seams the inclination is generally at an angle of 50-60 degrees from the horizontal over the waste.
- An inclination less than 45 degree produces less gas, causes greater dilution of the gas (because of the larger leakage of air into the hole) and increases the chances of jamming of the bore-rods in the hole.
- Sometimes good results have been claimed with holes inclined towards the face.

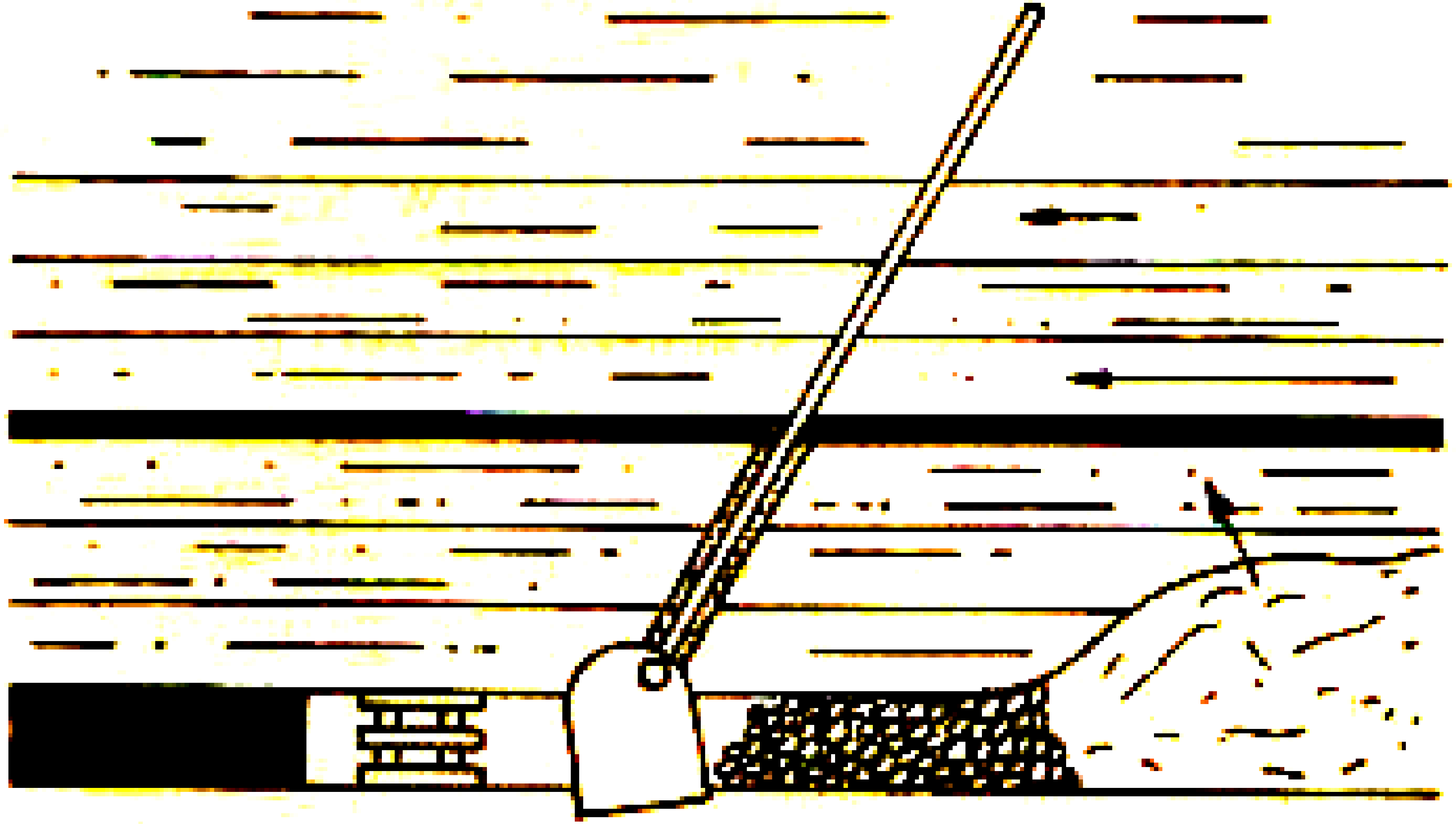


Fig. 1.2 Cross-measure borehole method of methane drainage.

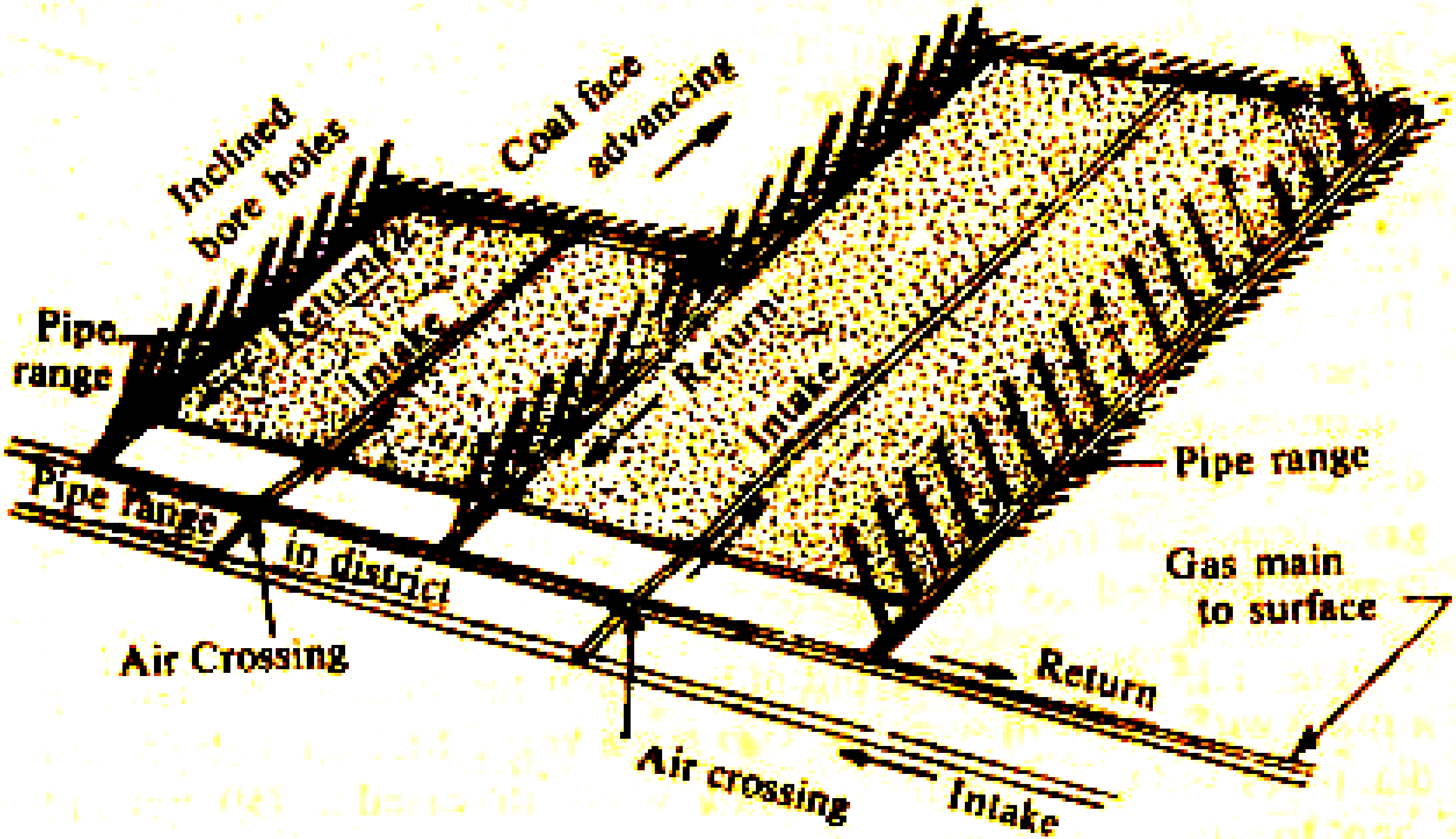


Fig. 1.15. Methane drainage (underground pipe system at a long wall face and layout of bore holes)

Gas holder

layout of bore holes)

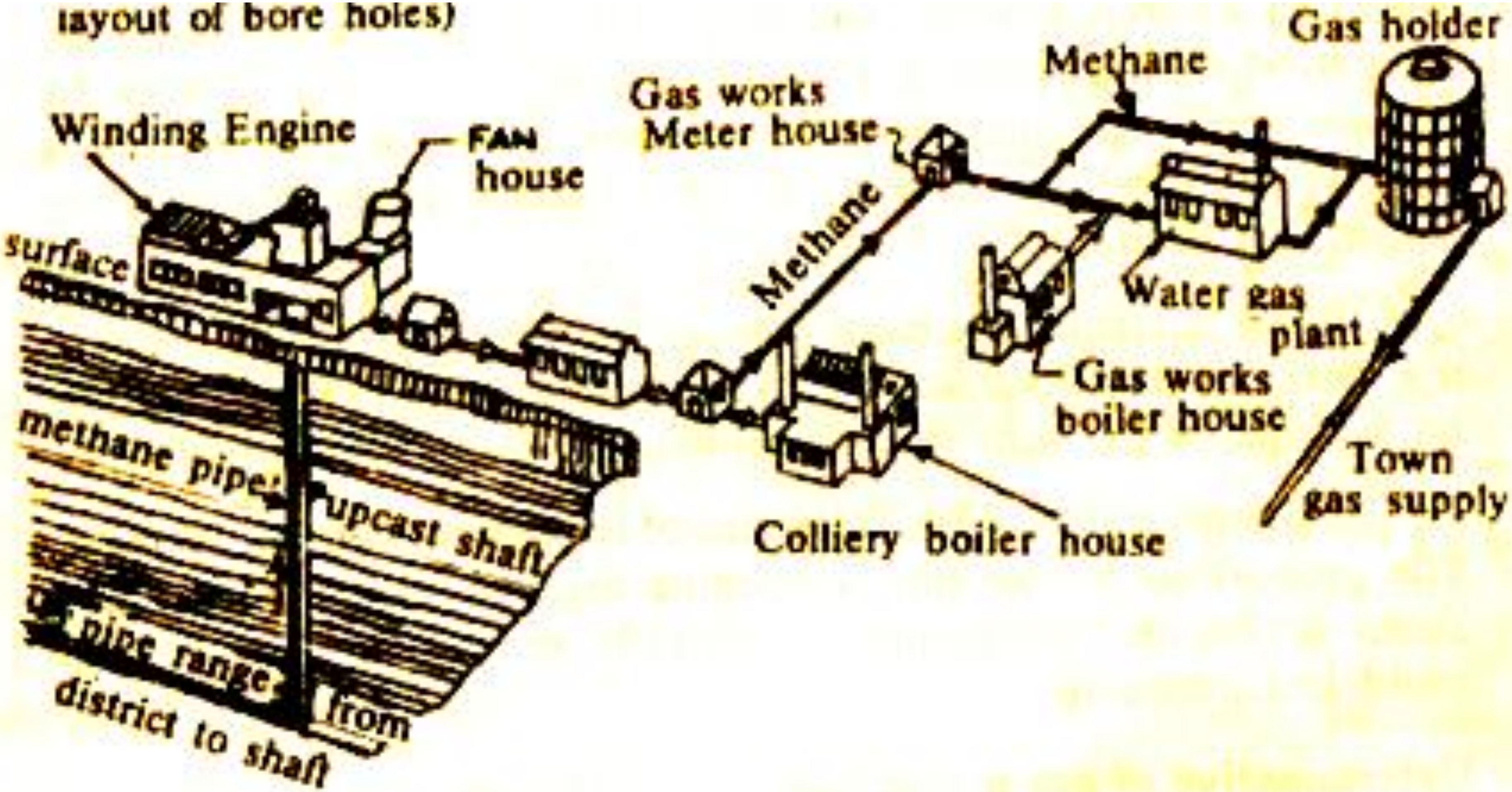


Fig. 1.16. Methane drainage; schematic layout at the surface

- Normally boreholes are placed in the return airway, since the ventilating pressure drives the gas in the goaf towards the return airway.

- Besides, the haulage in the intake makes it difficult for the bulky drill to operate due to lack of space.

- All these considerations normally weigh in favour of placing the boreholes in the return.

- The boreholes are usually 65-90 mm in dia. and spaced at intervals of 20 to 30 m along the road so that they are not too close to each other to be very costly nor they are too far apart for adequate drainage.

- Their length varies from 15 to 100 m (commonly 35-40 m) depending upon the adjacent gas-bearing seams which have to be intersected for drainage.

- The holes are started off with a dia. of 115 mm and collar pipes 10m long and 90 mm in dia. are connected to them before they are drilled to the full length.

- The holes for CH4 drainage need special drilling machines capable of drilling long holes of large diameter cheaply.

- One such machine which found suitable is the 4.5 kW Nusse and Graffer Fortschritt PIV/6 pneumatic-powered rotary drill having a rotational speed of 125 to 250 rpm and using multi-point fir-tree type of bits.

- Usually the rate of gas emission rises for the first two weeks until a maximum is reached at a distance of 30 to 300 m from the face, after which the rate of emission falls.

- A suction of less than a hundred to a few thousand pascals is necessary to drain the gas, the usual suction being 1000 to 1500 Pa.

- the suction should be high enough to overcome the friction of the pipe ranges, but, at the same time, should not be so high that air may leak into the goaf and dilute the methane.

- The quantity of methane drained by cross-measure borehole method has been found to be such that the methane discharged into the ventilation system is decreased by 50-60% or sometimes more.

- Of all the methods, cross-measure borehole method is the simplest and cheapest, but its yield of gas is less than Hirschbach method.

Cross-measure boreholes

- Cross-measure boreholes are drilled with various design principles for the purpose of draining roof and floor rock strata as they relax during mining.
- In Europe, due to the greater depths of the longwall mines, cross-measure boreholes are preferred over GGVs (Gob Gas Ventholes).
- These boreholes are drilled at an angle over the longwall panel and oriented away from the advancing face so that they drain gas from the entire length of the relaxed zone on the return air side of the panel.
- Generally, cross-measure boreholes drilled behind the longwall face achieve higher production efficiencies and maintain higher gas purities than those drilled in front of the coal face.

- In longwall mining operations, strata below the mined seam may be a major gas source, too, if they contain gassy seams or gassy sandstones. In these situations, one advantage of cross-measure boreholes compared to GGVs is that they can be drilled at an angle into the strata below the mined coal bed to drain the gas of underlying formations so it does not enter the mining environment.
- The angle of cross-measure boreholes may vary from 20° to 60° from horizontal. At least one hole is drilled at each site, but hole inclination and spacing can be different based on the gassiness of the floor and roof as well as geotechnical considerations for hole stability.

- In order to obtain an effective drainage of mine gas, sealing of the casing collar in cross-measure boreholes is very important. A smaller diameter liner is inserted and cemented at the borehole collar to maintain the production.
- The gas produced from cross-measure boreholes may vary in rate and concentration depending on the sealing of the borehole and gassiness of the gob. However, in any case, these boreholes are connected to a larger pipeline system underground and the gas is withdrawn with a vacuum system

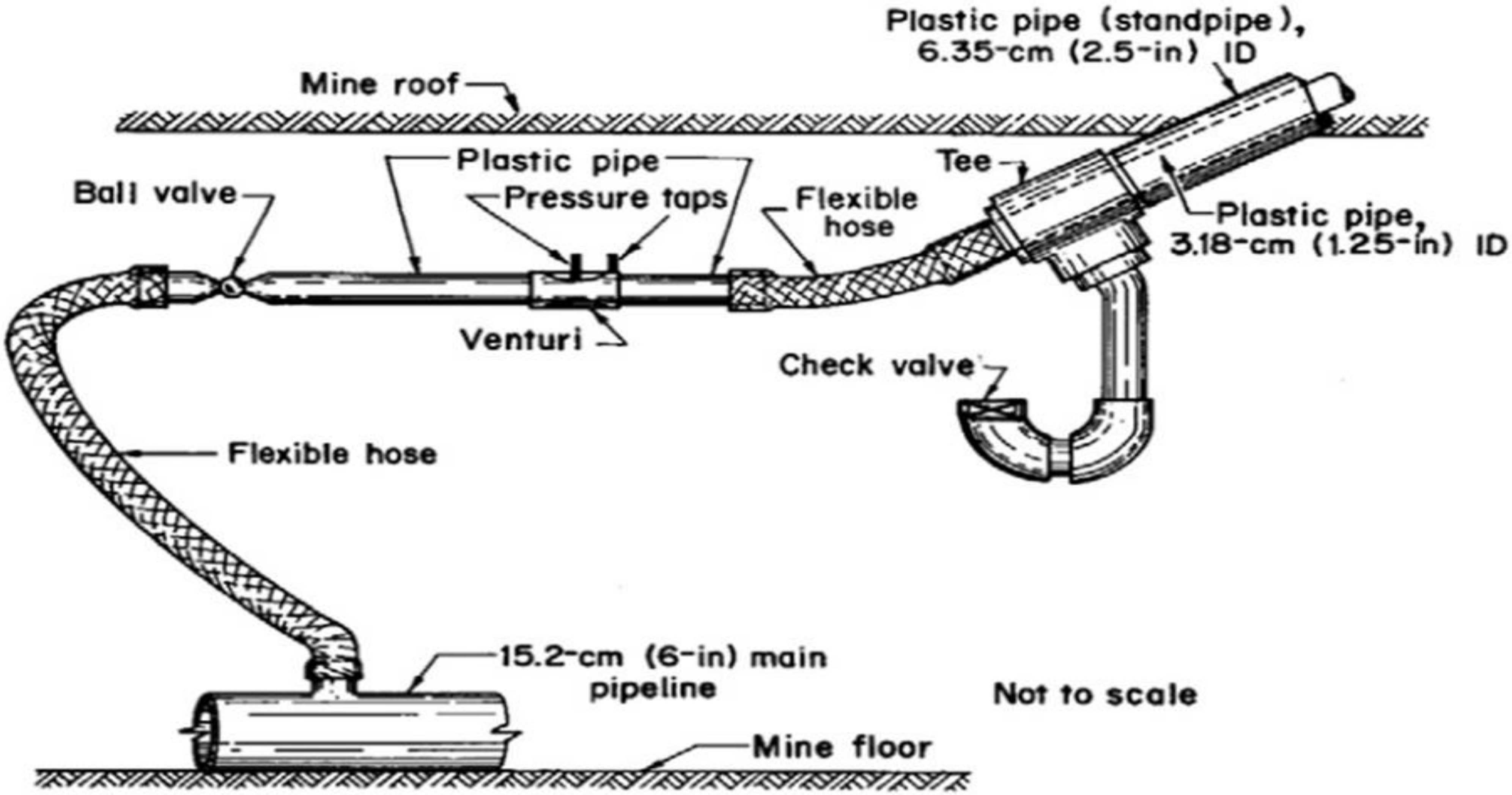


Fig. 12. Example of typical gas-gathering system for cross-measure boreholes. From Diamond (1994).

16.2.2 Cross-Measure Borehole Method

This is by far the most popular method of methane control on European longwall faces. Fig. 16.5 shows a plan and elevation of a typical layout for a retreating longwall face.

Boreholes 2–4 in. in diameter are drilled from the top gate to a depth of 60–500 ft. The angle of these boreholes with respect to horizon varies from 20 degrees to 50 degrees, while the axis of the borehole is inclined to the longwall axis at 15–30 degrees towards the gob. At least one hole in the roof is drilled at each site, but several boreholes in roof and floor can be drilled at varying inclinations depending on the degree of gassiness. Drill sites are typically 80 ft apart. These holes are then manifolded to a larger pipeline system, and gas is withdrawn using a vacuum pump. Vacuum pressures applied vary from 4 to 120 in. of water gage. The amount of methane captured by the drainage system expressed as a percentage of total methane emission in the section varies from 50 to 90%. Some typical data from British mines are given by Kimmins [6] and shown in Table 16.3.

Table 16.3 Methane Capture Ratios for Cross-Measure Borehole Method

Mine	Specific Methane Emission (ft^3/ton)[a]	Methane Capture Ratio (%)	
		Section	Mine
Ashley Green	3200	60	38
Haig	3000	59	20
Parkside	2800	61	42.6
Point of Ayr	5700	68	47.7
Sutton Manor	3300	70	40.0

[a] This is the total methane emission from a mine divided by the tonnage mined every day. These are highly gassy mines.

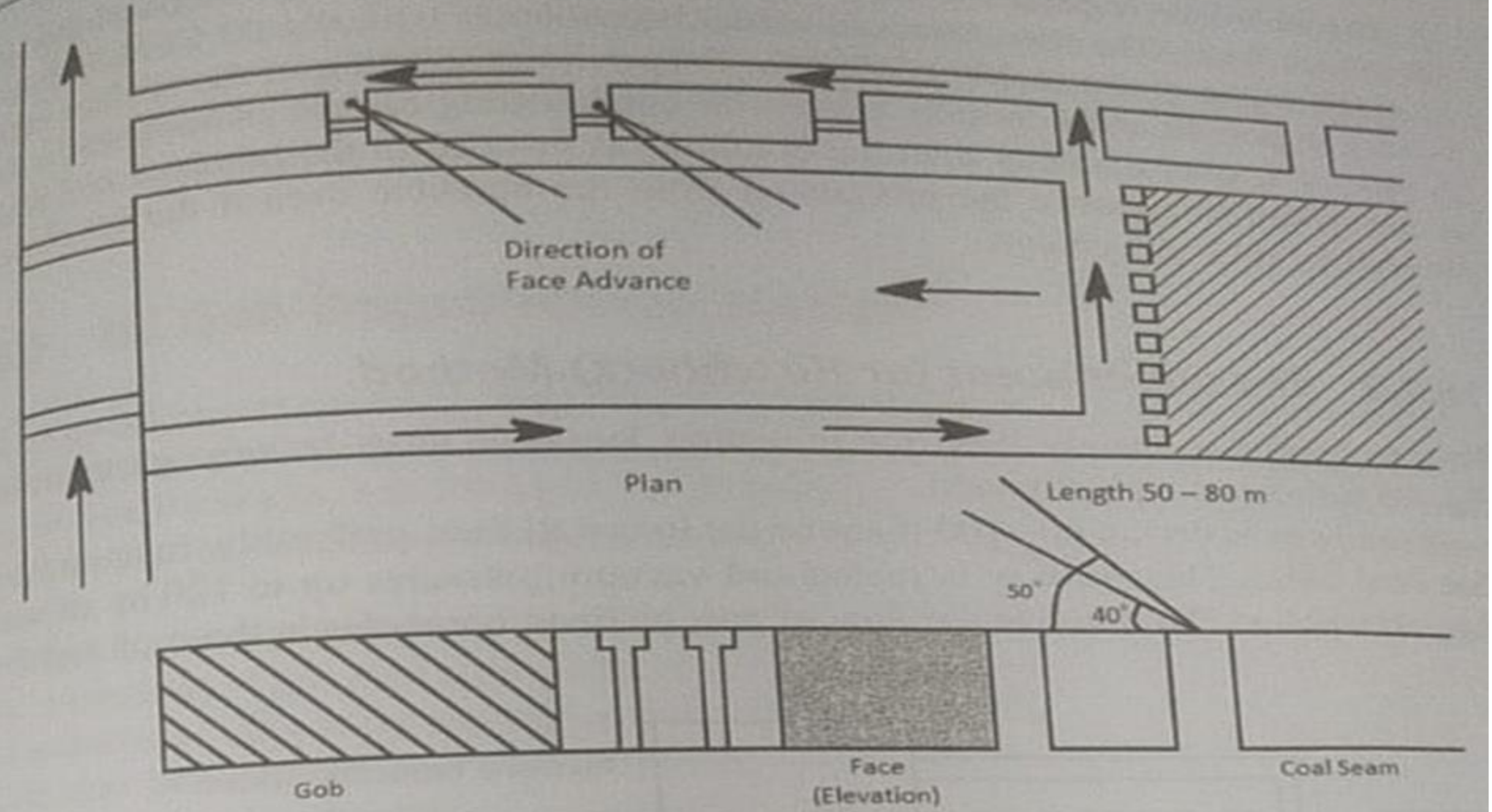


Figure 16.5 Methane drainage with cross-measure boreholes.

The technique is generally more successful for advancing longwall panel than it is for retreat faces. The flow from individual boreholes is typically 20 CFM, but occasionally, it can go up to 100 ft^3/min for deeper holes. Sealing of the surface casing is very important and is usually done with quick-setting cement. Sometimes, a liner (a pipe of smaller diameter than the borehole) is inserted in the borehole and sealed at the mouth to preserve the production from the borehole even if the borehole is sheared by rock movements.

Superjacent or Hirschbach Method

- This method is applicable where an unworkable seam exists some 25 to 35 m above the seam being worked.
- In this method, headings with cross-sectional area of 5 to 7 m^2 are driven at a height of about 25 to 30 m on top of the working seam.
- They are so positioned that their vertical projections lie midway between the gate roads in the working seams.
- It is better to locate the drive in a coal seam at least 0.3-0.4 m in thickness if such a seam is available. Otherwise, they may be driven in stone.
- For economy, an already existing drift or one driven for some other purpose may be chosen for methane drainage.
- Both along-the-seam and cross-measure boreholes are drilled from these headings.
- Then the headings are sealed at the outbye end by dams through which pipes are left.
- Methane is drawn from the headings through these pipes by applying a suction of 203 kPa.

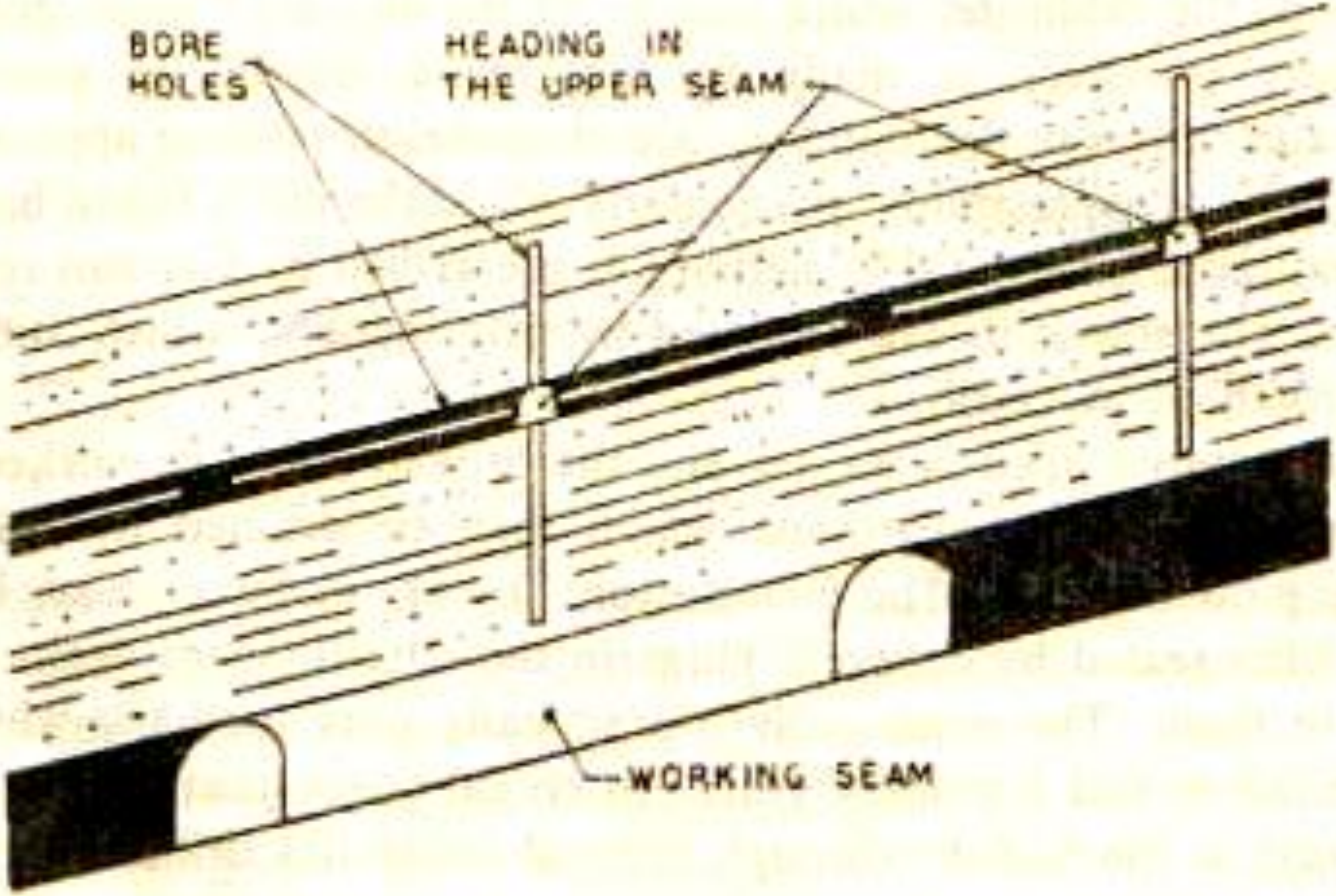


Fig. 1.3 Hirschbach method of methane drainage.

- This method is prevalent in mines in Eastern Europe and China.

Advantages and disadvantages of Hirschbach method

- Hirschbach method yields the maximum quantity of gas with a high methane percentage.

- Another advantage of Hirschbach method is that the driving and drilling operations are done outside the seam and hence do not interfere with normal mining operations.

- For retreating longwall and bord-and-pillar workings, the Hirschbach method is the only suitable method.

- This method is not very successful when the seam being worked has a massive sandstone cap because enough roof fissures are not developed with such a roof and as a result the gas flows more easily to the face than to the drainage drift.

16.2.3 The Superjacent (or Hirschback) Method

This technique is mainly used for retreating longwall faces in very gassy seams. Fig. 16.6 shows a typical layout.

A roadway is driven 60–100 ft above the longwall face, preferably, in an unworkable coal seam. The roadway is sealed and vacuum pressures up to 120 in. of water gage are applied. To improve the flow of gas, inclined boreholes in the roof and floor

are drilled to intersect other gassy coal beds. If mining scheme proceeds from the top to the bottom seams in a basin, the entries in a working mine can be used to drain coal seams at lower levels. Methane flow from these entries is high, averaging 700–1000 CFM for highly gassy seams. Nearly 50% of total emission at the longwall face has been captured [7].

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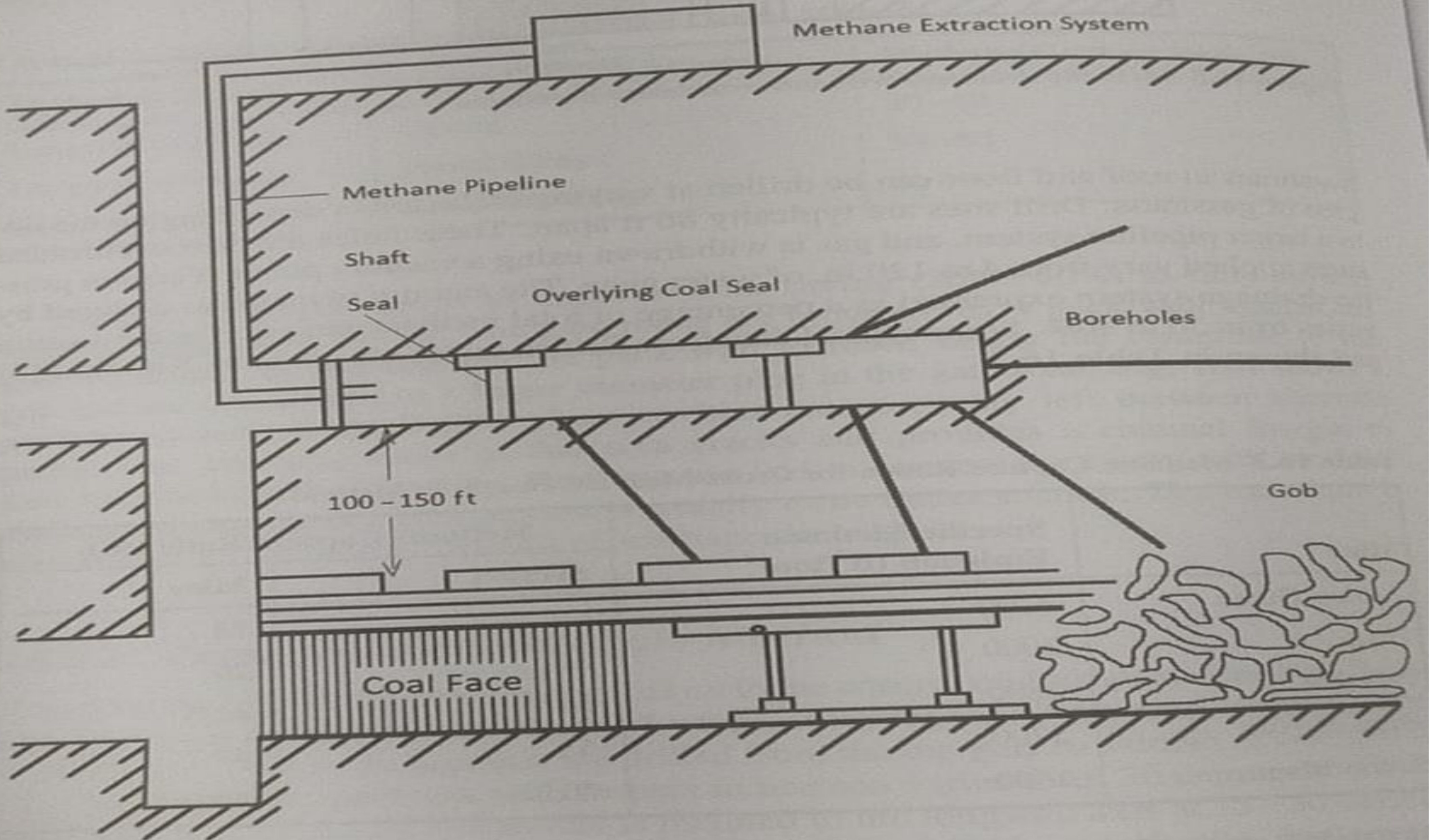

Figure 16.6 Methane drainage by superjacent method.

Longwall gob gas ventholes

- Gob gas ventholes are drilled into the overburden above longwall panels to capture the gas released from the subsided and relaxed strata before it enters the mining environment, where it can be an explosion hazard.
- Most gob gas ventholes are drilled within a short distance, 10–30 m (30–100 ft) of the coal bed being mined, and cased with steel pipe. Commonly, the bottom section of the casing is slotted and placed adjacent to the expected gas production zone in the overburden strata.

- The usual practice is to drill the gob gas ventholes from the surface prior to mining. As mining advances under the venthole, the gas-bearing strata that surround the well will fracture and establish preferential pathways for the released gas to flow towards the ventholes.
- Exhausters are placed on gob gas vent holes to maintain a vacuum on the wellbore so that they operate at the minimum possible flowing pressure and create a pressure sink in the overburden strata to induce gas flow towards the venthole.

- Gas production from gob gas ventholes may exhibit variable gas quality. In the early stages of production, the gas quality is generally high (>80%), and there is very little contamination by mine ventilation air. Maximum daily methane production generally occurs within the first several days after a hole is intercepted by the longwall.
- Relatively high production rates are usually sustained for only a few weeks or in some cases for a few months. Later in time, gob gas production may exhibit decreased methane levels as ventilation air is drawn from the active mine workings.

16.3 US Gob Degasification Method

US longwall panels are much larger than European longwall panels and are mined at a faster rate. Cross-measure boreholes simply cannot drain enough methane to keep the bleeder entries at less than 2% methane as required by Federal regulations [8]. Thakur [9] estimated the feasible ventilation air quantities in modern longwall mines as shown in Table 16.4.

The bleeder air, therefore, can only capture a small fraction (15%–30%) of total gob emissions. Gob drainage technique must capture 60%–80% of the total gob gas emissions. The only technique that can do this is the use of vertical gob wells. Their size and number will vary with the rate of gob gas emissions and will be discussed later in the chapter.

16.3.1 Construction of a Vertical Gob Well

Fig. 16.7 shows the vertical section of a typical gob well.

A 12–15 in. surface casing is set at the bedrock for a depth of about 100 ft. Next, a $9^5/_8$–$12^1/_4$ in. borehole is drilled to a depth below all water aquifers and a $7^1/_2$–$9^5/_8$ in. casing is set. Next a $6^1/_4$–$7^7/_8$ in. borehole is drilled to the top of the coal seam being mined stopping 30–90 ft above the coal seam. A $4^1/_2$–$6^1/_2$ in. diameter casing is lowered in the borehole, and it is anchored in a strong stratum about 300–1000 ft above the coal seam depending on the depth of the coal seam. The casing below this point is not cemented but slotted to allow gob gases to enter the gob well. The slots are typically 1 in. wide × 2 ft high and are cut at different locations on the perimeter of the casing like a spiral. This preserves the integrity of the casing. For shallow coal seams, old casings or pipes can be used but for deeper coal seams, new J55 or K55 casings are recommended. The size of the gob well casing varies from $4^1/_2$ to $12^1/_4$ in. outside diameter depending on the volume of gas to be drained.

Table 16.4 Feasible Ventilation Quantities for US Longwall Faces

Category of Coal Seam	Face Intake (CFM)	Tailgate (CFM)	Bleeders (CFM)
Mildly gassy	30,000	25,000	100,000–150,000
Moderately gassy	50,000	40,000	150,000–250,000
Highly gassy	80,000	60,000	250,000–350,000

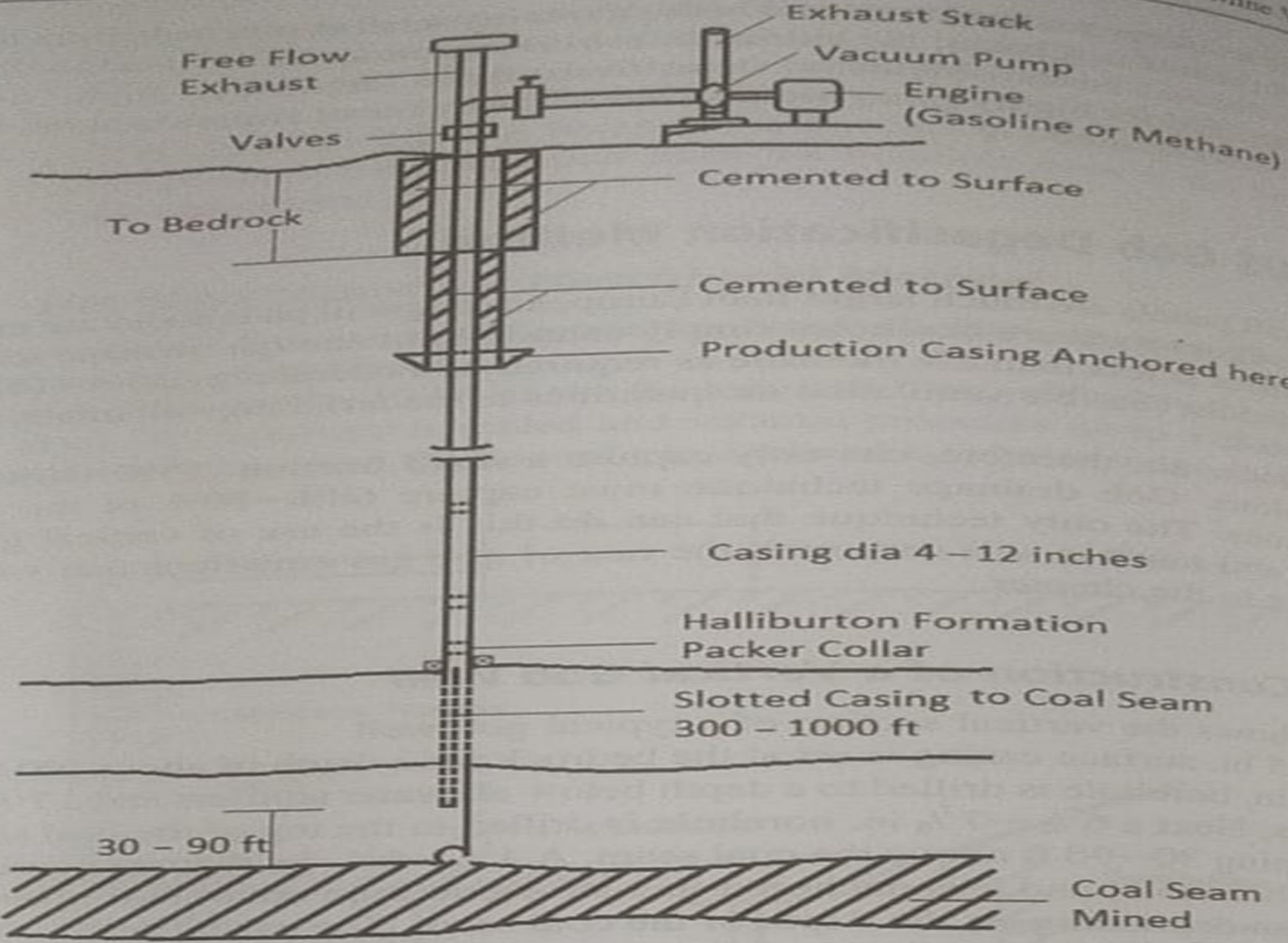

Figure 16.7 Vertical section of a typical gob well.

16.3.2 Location of Gob Wells on the Longwall Panel

The first gob well is usually installed within 50–500 ft from the setup entry. When the longwall face retreats 100–200 ft, the first main roof fall takes place releasing a large volume of methane. Sometimes, it is necessary to have two gob wells in parallel near the setup entry to cope with the onrush of strata gases. Location of other gob wells on the panel must be done in an optimal manner to capture the maximum percentage of total gob gas emissions at the minimum cost.

Optimum gob gas drainage depends on the following:

- The size of the gob well and its production capacity.
- Distance of the gob well from the tailgate.
- Spacing of the gob well on the longwall which is a function of the width of the longwall panel and the rate of mining.

16.3.2.1 The Size of Gob Well and Gas Production Capacity

Coal industry in the United States uses gob wells with diameters ranging from 4 to 12 in. Moderately gassy mines use 4—7 in. diameter casings but highly gassy mines use bigger casings. The most popular size is 12 in. in diameter. The cost of drilling larger diameter gob wells increases exponentially.

All gob wells are assisted in gas production by a well-designed blower. Lampson blowers (Series 600, 800, and 1200) are commonly used blowers and have a good track record. Operating at a suction pressure of approximately 1—3 psi the gas production volumes are as follows:

Casing Diameter	Gas Production
6 in.	1—2 MMCFD
9 in.	2.5—3.2 MMCFD
12 in.	4.5—5.0 MMCFD
15 in.	7.0—8.0 MMCFD

Assuming an average of 70% methane in the gob gas, a single 12 in. diameter gob well can remove 3—4 MMCFD of methane from the gas emission space.

16.3.2.2 Distance of Gob Wells From the Tailgate

For best efficiency, all gob wells must be located between the centerline of the longwall panel and the tailgate. On an average, best results are obtained when the gob wells are located about 100 ft from the centerline toward the tailgate as shown in Fig. 16.8.

Gob wells located on the headgate side of the longwall gob produce significantly lower amount of gas and thus are very inefficient.

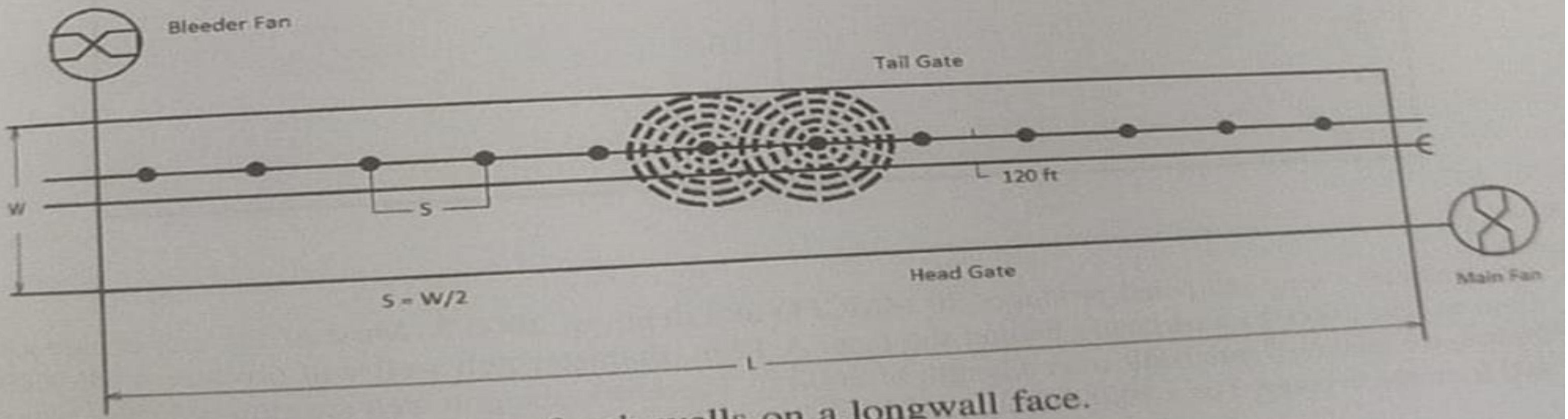

Figure 16.8 Optimum layout of gob wells on a longwall face.

16.3.3 Gob Well Spacing on the Longwall Face

It was earlier shown that the effective length of the gob producing most gas is limited to 1.3× depth immediately behind the face. Gas removed by the bleeders is discounted here to provide a little reserve capacity for the gob wells to handle peak emissions. Knowing the gob well production capacity, the number of producing gob wells in the gas emission space can be calculated by simply dividing the total emissions by the production capacity of the gob well. The total number of gob wells for the panel can be calculated by prorating this number by the ratio, the length of panel/the length of gas emission space.[1] Table 16.5 shows the specific gob emissions as observed for different widths of longwall panels in a highly gassy coal seam in Virginia. Specific gob emissions tend to increase with the width of the panel.

The optimum width of a longwall panel is the width where gob wells are most efficient in draining the gob gases and the total number of gob wells for the panel is the minimum. The most efficient gob drainage is reached when the spacing between the two adjacent gob wells (s) is equal to half the width (w) of the longwall panel. A ratio, s/w that is less than 0.5, indicates inefficient methane drainage. To illustrate this point, spacing of gob wells for longwalls with different widths but the same tonnage of extraction is calculated. The following assumptions are made for this calculation:

1. The rate of extraction is the same for all longwall panels, one acre per day.
2. The longwall face is 10,000 ft long and needs two gob wells near the set up entry.
3. A gob gas capture ratio of 70%–80% will be achieved.
4. Specific gob emission is 30 MMCF/acre.

Table 16.6 shows estimated total number of gob wells for various widths of longwall panels.

Fig. 16.9 shows a plot of s/w against longwall face widths. The most efficient capture of gob gas is obtained when s/w = 0.5 or the longwall width is 700 ft. Because the

Table 16.5 Specific Gob Emissions for Longwalls in Highly Gassy Seams

Width of Longwall Face (ft)	Specific Gas Emission (MMCF/acre)
450	25
600	30
750	33
900	36
1050	40

[1] An example: a longwall panel produces 30 MMCFD at a depth of 2000 ft. Most of the gas is produced from an area 2600 ft immediately behind the face. A 12 in. diameter gob well will produce 4 MMCFD. Hence, we need 6–7 gob wells over a length of 2600 ft. Therefore, the gob well spacing is 370–430 ft or 400 ft on the average. For a 10,000 long panel, total number of gob wells is at least 25.

Table 16.6 Number of Gob Wells Versus Longwall Width

Width of Face (ft)	Number of Gob Wells	Spacing/Width (s/w)
450	24 + 2	0.93
600	26 + 2	0.64
750	28 + 2[a]	0.48
900	32 + 2[a]	0.35
1050	36 + 2[a]	0.26

[a]Total number of gob wells could be slightly higher because of declining capture efficiency.

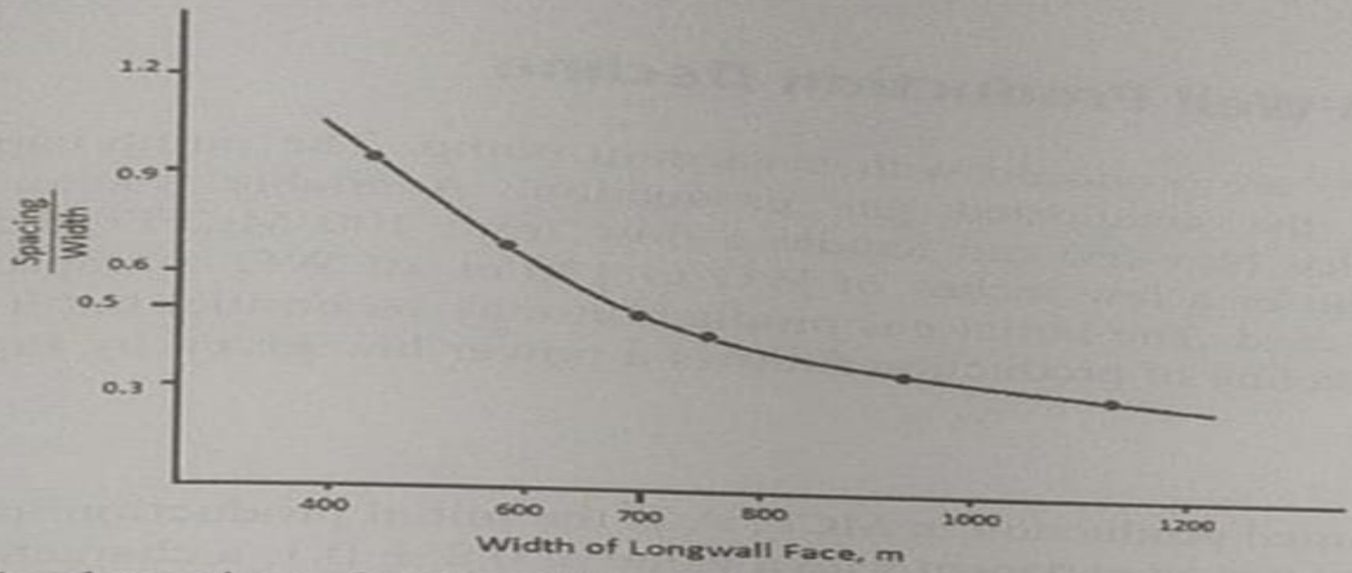

Figure 16.9 Optimal spacing of gob wells on a longwall face.

gob wells are offset from the centerline by 100 ft, the optimum width where gob gas drainage is most efficient is in the range 700—800 ft or 750 ± 50 ft.

16.4 Gas Capture Ratios by Vertical Gob Wells

Vertical gob wells provide a great flexibility in coping with different sized longwall panels mined at low, medium, or high rates. The high cost of longwall equipment requires a high rate of mining (70–80 ft/day) for adequate return on the investment. The capture ratio depends on both the number of gob wells and the rate of gob gas emissions for the longwall gob. Table 16.7 shows typical capture ratios for some US longwall faces.

Number of gob wells per panel and hence the capture ratio goes down, if the longwall is mined at a very slow rate (10–20 ft/day).

Table 16.7 Coal Gas Capture With Vertical Gob Wells

Coal Seam	Gassiness	Total Methane Emissions (MMCFD)	Gob Wells Per Panel	Capture Ratio (%)
Pittsburgh (PA and WV)	Moderately	4–8	5–6	40–50
Lower Kittanning (PA)	Mildly	2–4	3–5	30–50
Pocahontas #3 (WV)	Moderately	5–6	5–8	30–50
Pocahontas #3 (VA)	Highly gassy	25–30	20–35	65–80
Blue Creek/Mary Lee (AL)	Highly gassy	15–20	10–20	60–70

16.5 Gob Well Production Decline

Most gob wells are produced with a vacuum pump. The pump capacity is always matched with the anticipated gas production. Available vacuum pumps (also commonly called blowers) can handle a flow from 100 MCFD to 5 MMCFD and create a vacuum of a few inches of WG to 120 in. of WG. Lampson 650 and 850 are commonly used. The initial gas production may be erratic, but it settles down in 10 days. The decline of production follows a power law given by Eq. (16.1).

$$Q = A\ t^n \tag{16.1}$$

where Q is the total production in MCF, A is the initial production in MCFD, t is the time in days, and n is an exponent with a value of 0.8 ± 0.1, a characteristic of the gob emissions space.

Production declines for four gob wells are shown in Fig. 16.10 for longwall panels in the Pittsburgh seam of West Virginia, Lower Kittanning of Pennsylvania, and Pocahontas #3 seam of West Virginia and Virginia. The deeper gob well in Pocahontas #3 seam is about 2000 ft deep.

For design purposes, it was earlier assumed that the gob well will cease production when the longwall face has retreated 1.3× depth (ft), but in reality, they continue to produce some gas until the face has moved beyond 3000 ft regardless of the depth.

A longwall panel in a highly gassy mine becomes a source of low-cost gas. A typical 1000 × 10,000 ft panel with a specific gob production of 30 MMCF/acre will produce 6.9 BCF gas. Even at a low price of \$3/MCF, it can create revenue of over \$20 million. If this gas is marketed, it can defray the cost of degasification and ventilation of the mines. More of economics will be discussed later in the book in Chapter 20. Methane capture from sealed gob areas will also be discussed in Chapter 20.

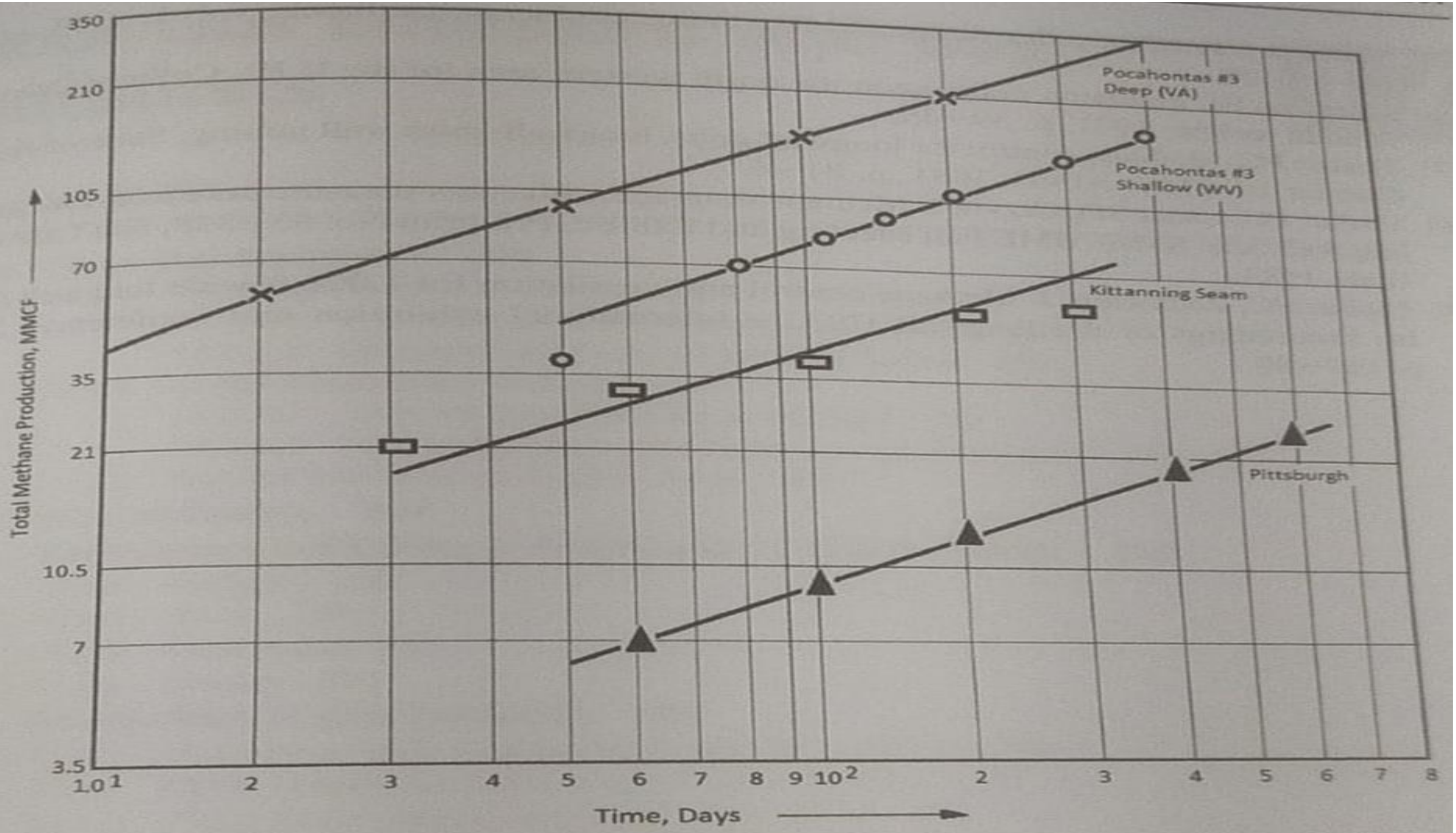

Figure 16.10 Gas production from a single gob well.