Modern Aerial Ropeways and the Environment

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Summary

The author shows how an aerial ropeway can be designed to suit particular environmental problems associated with a specific project. The ropeway solution is shown to be attractive both in cost competitive terms as well as in terms of its minimal environmental impact.

1. Introduction

Economic transportation of bulk material is of paramount importance to the mining and process industries of the modern world. The conveying of material adds no value to the end product, so economy and reliability are equally vital.

The modem aerial ropeway has shown that it is today a very economic and reliable form of transportation for bulk materials, particularly in undulating and rough terrain. Until recently, trucks were generally accepted as the 'best' means of bulk transportation, but with the increased cost of fuel, oil and labour, economic as well as technical questions are being asked at the evaluation stage as to their future acceptability.

A further area of evaluation is also becoming increasingly important in view of the generally accepted need to protect and preserve the environment. Frequently a mining company has to consider not only the mine area in which it is operating, but also the wider ranging aspects of the possible environmental and ecological effects of installing a transport system.

The usual parameters for consideration when assessing the effect on the environment of a particular system are: visual impact, noise, interference with land utilisation, and dust. Dependent upon the location of a project and its environmental or ecological interest, more emphasis may of course be placed on one or more of these parameters. Factors affecting the final decision can then be viewed in the context of a specific application, and in many cases when considered objectively the aerial ropeway compares very favourably with other transport systems. Examination of the relevant parameters will amplify this claim.

2. Visual Impact

A common initial objection to an aerial ropeway is its visual impact, principally stemming from the fact that local people cannot relate a ropeway to something that they understand. In some parts of the world the visual impact of a ropeway can be directly compared with a cabin-type ski-lift which people are able to appreciate and accept. The general objection to ropeways, however, is that they are normally constructed with lattice steel structures which are often associated with the large unsightly electricity pylons stretching across many parts of the countryside. This, however, is a misconception as in many cases where a ropeway is installed alongside electricity pylons the ropeway towers fade into the countryside by comparison with the larger units of the electrical distribution system. With an aerial ropeway, however, this particular objection can, if required, be overcome by using single column plated towers as has been frequently adopted for passenger carrying ropeways. Almost invariably such ropeways are situated in National parks or areas of scenic beauty where appearance is of prime importance (Fig. 1).

Fig. 1: Passenger-carrying ropeway, operating in an American amusement park, illustrates how the slender towers easily merge with the surrounding trees

BRECO have many examples where towers of this type have been used on National Trust properties, even on open hills with no trees, and it can be shown that the structures are almost invisible when viewed from neighbouring hills. Where the countryside is of open farm land type with reasonable tree-lined areas there is no real problem in camouflaging the towers. Naturally great care is taken in positioning the towers where possible near hedgerows or coppices so that a minimum of towers are used on open ground. In addition, heights of the towers can be kept as low as reasonable clearances permit to lower the overall profile of the plant. This also provides a form of camouflaging of the moving buckets which can be painted if necessary in suitable colours. The movement of the buckets is at relatively slow speed and is certainly not noticable compared with motor traffic on open or country roads.

We can provide at least one example of an industrial ropeway where the appearance was of such importance (as the installation was in wooded country surrounded by hills), that the route of the ropeway was specifically selected to suit the environment. To overcome objections from local people as well as Government bodies, the route was selected and planned to take full advantage of the natural contours afforded by the undulating countryside so that the completed ropeway is concealed in the landscape as far as possible. This ropeway is impossible to photograph from the surrounding hills, and even the local farmers are unable to say exactly where the line passes when viewed from a hilltop overlooking the valley. It can only be seen at road crossings and even here at one point the line was lowered to pass under a road and through a tunnel. In this instance it was considered that a reinforced concrete design of trestle would blend in more attractively with the landscape than would steel and this has been adopted wherever possible on this installation, as well as others where similar objections have been raised (Figs. 2 and 3).

Fig. 2: Concrete towers are sometimes used to blend into the countryside

Fig. 3: Even on an open hillside ropeway towers are not easily visible to the casual observer

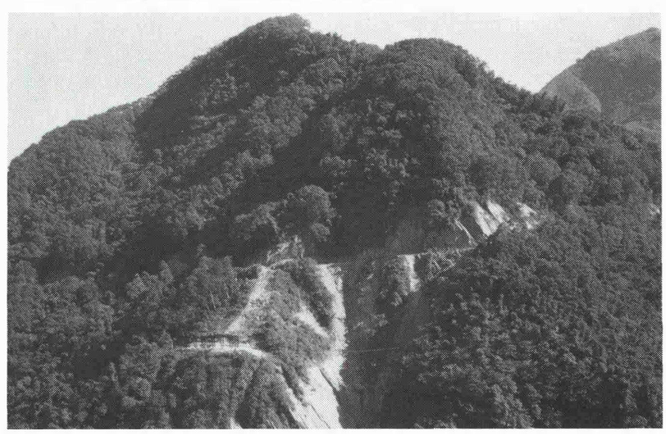
3. Noise

With the development of nylon tyres for use on bicable ropeway carriages a side benefit has resulted from the point of view of noise. Nylon tyred or solid nylon wheels are extremely quiet in operation both on terminal rails and particularly on the supporting ropes along the line of a bicable ropeway, where noise levels are likely to be criticised. Today the modern bicable ropeway can be considered to be the quietest form of powered transport available and is virtually noiseless in operation along the line. The bucket carriages fitted with nylon lined wheels are barely audible beyond a range of 10 metres. In fact, great care has to be exercised by maintenance personnel working in areas where the buckets pass near to the ground at terminals because of the quiet approach of buckets. Normally such areas are, of course, fenced off in view of these dangers. Compared with road vehicles and the constant clatter noise of conveyors, ropeways are virtually noiseless. Naturally, where plant and machinery is installed at terminal and intermediate stations there is a degree of noise inherent in any type of machinery, but this can be minimised by enclosing drives within suitably designed buildings at loading or unloading points, and the result can be demonstrated to be perfectly acceptable.

4. Interference with Land

Since the base of a modern plated type ropeway tower is no more than about 600/900 mm square above ground the loss of land area is insignificant, especially as ropeway towers can be spaced out at considerable distances. The height of the line is designed to provide whatever clearance is required for the safe passage of farm vehicles underneath and it is not normally necessary to arrange fencing of any kind. It is usual to have a strip of land over which the ropeway passes purchased by the owner and defined as the right of way of the operator for access to towers etc. It is, however, not normally fenced and farm work, as well as the migration of animal life is not interrupted. There is, of course, very occasional usage of the land by the operator when for example track ropes on a bicable ropeway are renewed and this can, of course, be prearranged with the farmers at a suitable time between crops. In addition there is little doubt that compared with any other type of plant, ropeways cause the least disturbance to the ground over which the line runs. Supporting towers can be spaced to span rivers, gorges etc., and the minimum of foundation and excavation work is required (Fig. 4).

Fig. 4: In this densely forested hill country in Taiwan the line of an aerial ropeway makes little visible impact



5. Dust and Spillage of Material

The main problems associated with spillage of materials on ropeways emanate from the nature of the material being transported. In general, with automatic ropeway loading systems, it can be ensured that the buckets are not overfilled, which would tend to cause spillage in transport. Naturally efforts by the designer can usually be overridden by the operator and in this respect careful monitoring of operational staff is necessary. One problem, of course, is dust, particularly where dry fine material is being handled. Certain materials, such as limestone, are generally harmless, except perhaps visually, but other materials such as alumina and fine sand cannot be carried in open buckets due to their fine powdery nature. Occasionally (as in the instance of the ropeway described under the Visual Impact heading or near a catchment area for a water reservoir) the buckets are provided with lids to prevent dust blowing off. In some cases special buckets are developed to deal with a particular problem and also special methods of filling the buckets have to be provided (Fig. 5).

Fig. 5: Totally enclosed buckets for very fine material prevent dust being ejected on the line

6. Conclusion

The above comments illustrate how an aerial ropeway can be designed to suit the particular environmental problems associated with a specific project. The results of one study are shown in Table 1 and relate to a project under review in the United States of America. It can clearly be seen that the aerial ropeway solution came out best in all areas considered, with the exception of the category 'Socioeconomics' where it was considered that the truck solution would provide more jobs. Table 1 summarises the position of the aerial ropeway and the environment.

Table 1: Alternative haulage method analysis decision matrix

Parameter		Haul Road		Conveyor		Aerial Ropeway	
	R	Q	Q×R	Q	Q×R	Q	Q×R
Annual Cost	1.00	1.00	1.00	0.50	0.50	0.31	**0.31***
Operating Problems	1.18	0.80	**0.94***	0.80	1.18	1.00	1.18
1. Fuel and Energy Use	1.18	1.00	1.18	0.01	0.01	0.00	**0.00***
2. Surface Disturbance	1.30	1.00	1.30	0.28	0.36	0.24	**0.31***
3. Air Quality	1.37	1.00	1.37	0.90	1.23	0.90	**1.23***
4. Visual	1.53	0.80	1.53	1.00	1.38	0.90	**1.07***
5. Water Quality & Use	1.63	1.00	1.63	1.00	1.63	1.00	1.63
6. Noise	1.73	1.00	1.73	0.75	1.30	0.53	**0.92***
7. Irretrievable Resources	1.86	1.00	1.86	0.81	1.51	0.54	**1.00***
8. Reclamation	1.86	1.00	1.86	0.16	0.30	0.10	**0.19***
9. Socioeconomics	1.86	0.28	**0.52***	1.00	1.86	1.00	1.86
10. Property	2.00	1.00	2.00	0.18	**0.36***	0.37	0.74
11. Wildlife	2.17	1.00	2.17	1.00	2.17	0.90	**1.95***
12. Geologic Stability	2.36	1.00	2.36	1.00	2.36	1.00	2.36

	Haul Road	Conveyor	Aerial Ropeway
Summation A: All factors considered	21.14	16.06	14.75*
Summation B: Factors in reverse order	21.15	14.27	13.68*
Summation C: Environmental factors only	19.21	14.62	13.26*

R = Relative Importance Factor
Q = Quantified Impact: 1.00 = Greatest impact, other numbers as proportionally less.
Q×R = Impact: Lowest number = least impact = best choice
Best = *

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