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Planning Winter Sports Areas
Michigan State University Extension
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C. A. Gunn
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Planning WINTER SPORTS AREAS



✓ LOCATION

✓ SITE
SELECTION

✓ SITE
PLANNING

✓ BUILDING
PLANNING

By C. A. GUNN

MICHIGAN STATE UNIVERSITY

Cooperative Extension Service

East Lansing

FOREWORD

The recent boom demand for winter enjoyment in Michigan has stimulated the growth of winter sports areas throughout the state. Areas in existence ten years ago have now expanded greatly while the number of areas in the state has increased over ten times in the same period.

A natural corollary of this growth has been the increasing need for guidance in the physical development of properties. The experience and ingenuity of skilled skiers and operators of successful businesses elsewhere, as well as in Michigan, have resulted in the establishment of some very fine winter sports areas in this state.

Even so, much of the development has been on a trial-and-error basis. Many operators have paid severely for their mistakes. Several have indicated that if they were to do it again, they would be more careful in the selection of a location. Therefore, a study of the problems of location, site selection, site development, and building design was begun. The results of this research, together with recommendations for development are herein presented.

The intent of this publication is to take some of the guesswork out of future expansion of present businesses or development of new ones. It is not intended to promote the establishment of new areas. This information should be of equal help to present and prospective operators, all those connected with the development of winter sports areas, such as landscape architects, architects, realtors, land planners, tourist and resort organizations, and the suppliers of products and equipment.

ACKNOWLEDGMENTS

The author wishes to express sincere appreciation to all those who so willingly cooperated in supplying information, recommendations, and comments which made this circular possible. Special credit should go to those people who are so well informed on winter sports development, such as Ben Van Sant, ski business consultant; Frank Dunham, publisher, *Skier*; and Stan DuRose, chairman engineering committee, Central U. S. Ski Association. Many operators of established ski areas in Michigan were generous in their analysis and recommendations, such as O. Lynn Mead, Sylvan Knob; Holland Capper, Manistee Ski Area; Fred Bocks, Caberfae; Morton Graddis, Mt. Holly; Albert Quall, Ishpeming Winter Sports Park; Gilbert Wells, Snow Valley; Stevie and Al Almon, Ski Village; and Jerry Fairbanks, Au Sable Ranch and Ski Club. Among others who assisted materially in the research and preparation of this circular were George Polich, formerly Brule Mountain; Ray McMullen, Cooperative Extension Agent, MSU; Charles Pennington, Otsego County Memorial Hospital; Frank Davis, East Michigan Tourist Association; H. Frank Beeman, Intramural Sports, MSU; Don Thomas, sporting goods; A. H. Eichmeier, Michigan Section, U. S. Weather Bureau; David Wilcox, Parks and Recreation Division, Michigan Department of Conservation; Gladys Knight, MSU; Robert McIntosh, MSU; and manufacturers of equipment for snow-making, tows, and ski lifts.

Cover photo and Fig. 13, Michigan Tourist Council, Lansing; Figs. 1 and 2, data from U. S. Weather Bureau, East Lansing; Fig. 8, East Michigan Tourist Association, Bay City; Fig. 9, Ishpeming Chamber of Commerce; Fig. 10, Ski Patrol Manual, Denver; Fig. 11, Pomalift, Denver; Fig. 12, Skiland Photo, Eagle River, Wis.; Fig. 14, Homberg Photo, Ishpeming; Fig. 15, Larchmont Farms, Lexington, Mass.; Figs. 16 and 17, West Michigan Tourist and Resort Association, Grand Rapids; Fig. 7, Echo Valley, Kalamazoo.

Planning Winter Sports Areas

By C. A. GUNN¹

INTRODUCTION

If you are considering the expansion of your present business or establishing a new one, where do you begin? In either case, it would seem appropriate to make a critical analysis of the location and site you now own or intend to buy. Therefore, the first section of this bulletin, "Before You Buy the Land", (below) gives you guidance on this very important first step.

How do you develop the site after you are confident you have a good one? While this requires expert and specialized help, some fundamentals are presented in, "Layout Suggestions," page 7.

While building design is the province of the professional designer, a summary of building planning and construction ideas appears in "Building Suggestions," page 11.

Application of these recommendations should result in better planned and built winter sports areas in Michigan. More specifically, if you are investing in land and buildings for winter vacationists, you should: 1) obtain a more desirable and profitable business for the money you invest; 2) make better use of Michigan's recreational lands; and 3) provide better service for those who patronize your area.

Before You Buy The Land

DETERMINE THE TYPE OF BUSINESS

Most winter sports businesses require similar location and site characteristics. Some differences do exist, however, and should be recognized before buying land. Because skiing dominates all other activities at winter sports areas, suitable hilly land for ski slopes is required. If however, you hope to provide tobogganing, skating, ice fishing, or other winter sports, suitable land must be obtained. If you intend to provide complete food service, lodging, and entertainment on the site, you may wish to attract guests during spring, summer, and fall to justify the added investment. To do this requires a location with trout streams, lake frontage, swimming beach, wild game, or other all-season attractions.

Four types of winter sports businesses are now appearing in Michigan:

Basic Ski Center—the minimum of facilities, providing for skiing only.

Winter Sports Center—as above, with other sports added, such as tobogganing, skating, ice fishing. Facilities for warming, snacks, first aid, equipment rentals, sales, and rest rooms are more complete.

Winter Sports Resort—as above, with complete food service, bar (optional), lodging, and entertainment on the site (rather than supplied by the nearby community).

Year-Around Resort—as above, with attractions and facilities for vacationists during spring, summer, and fall, as well as in winter.

SELECT THE BEST SITE

After determining the type of enterprise you wish to operate, you should search for the most ideal site. While this may seem costly to you when considering the price per acre, the cost of the site should be related to the income it can produce. Also, a cheap site often requires excessive land improvement (filling, grading, draining, planting).

ADEQUATE SNOWFALL

Much of Michigan has greater snowfall than any point between the Rocky Mountains and New England. This unique aspect of its climate, largely due to the influence of the surrounding Great Lakes, makes the state very well suited to winter sports.

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Reference to Fig. 1 shows that much of Michigan has over 60 inches of snowfall per year. Those areas with lesser annual averages must depend more upon artificially prepared snow. Snow-making equipment is available, but the added costs of installation, operation, and upkeep must be justified by increased volume of business.

LONG WINTER SEASON

As important as snowfall is the amount of cold weather to retain the snow. Fig. 2 illustrates relative differences in length of winter season. Reference to both Fig. 1 and 2 should assist in evaluating a location regarding the influence of weather.

SUITABLE AREA AND TOPOGRAPHY

A good winter sports site includes over 100 acres of both hilly and reasonably level land. (See Fig. 5 and 6). Skiing and tobogganing require elevation differences of over 100 feet and slopes from 10 to 60 percent² or over. Nearby, level (but well-drained) land is needed for building sites, parking areas, drives, and skating rinks.

In selecting sites for recreation skiing, three categories of skiers need to be considered: beginners, intermediates, and experts. For safety's sake,

²Slopes are usually expressed in percent, the ratio of height in feet for 100 feet of horizontal distance, rather than degrees.

each category needs a separate slope. At present, the greatest volume of patronage is from those of little or no skiing experience. Hence, the greatest number of slopes should be developed for beginning and intermediate skiers. In the future, as more skiers gain in skill, the more difficult slopes will be in greater demand.

By coincidence of its glacial history, Michigan has hilly land in most of the areas of heavier snowfall. Obtain topographic maps to help locate a suitable site. (See Fig. 5).

ORIENTATION

Several additional weeks of skiing are possible on those slopes which are properly oriented to the sun and wind.

Prevailing winter winds in Michigan are from the northwest and west. Therefore, a high percentage of snow blows away when the topography is such that severe exposure to these winds exists. Strong winds during severely cold weather cause enough discomfort to discourage use of the slopes. High ridges to the west or northwest of the areas to be developed protect the skier and tend to deposit more snow by slowing the velocity of snowladen winds.

Ideally, ski slopes or toboggan runs should face to the north or northeast to avoid damaging effects of the sun. Some successful runs have been made in an easterly direction, but only when

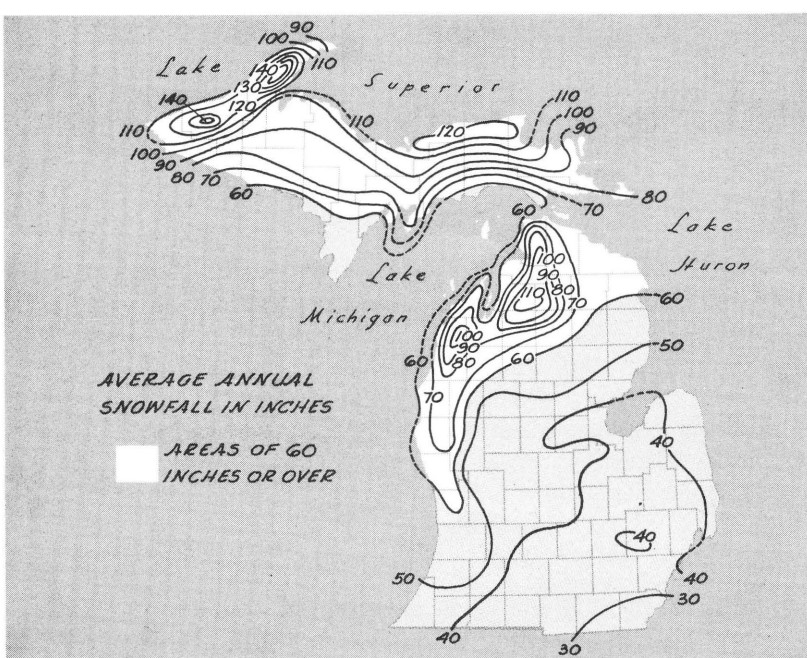


Fig. 1. An unusually heavy and non-uniform snowfall results from cold air waves sweeping down from the northwest over Lakes Superior and Michigan.

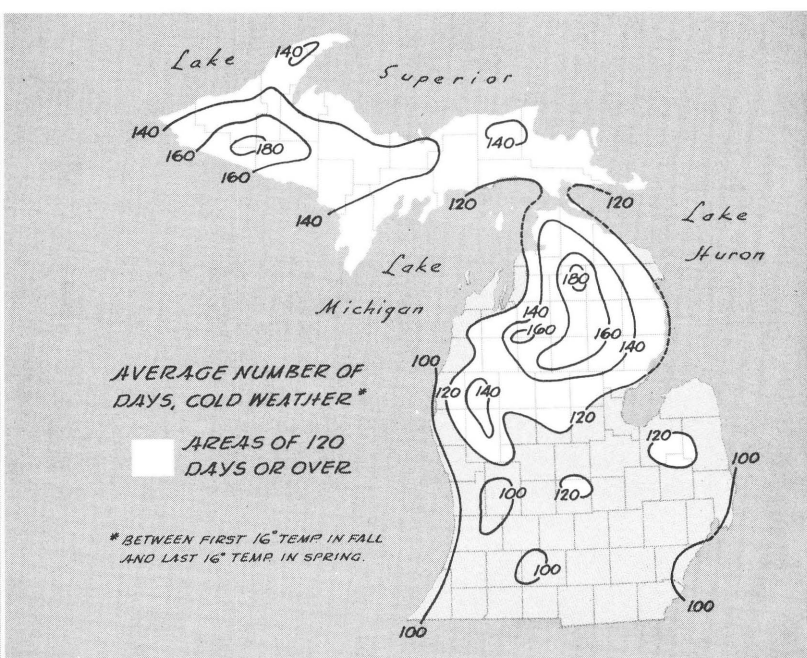


Fig. 2. The combination of semimarine and continental types of climate results in shorter winters in the coastal regions than in the interior.

other factors, such as width of cleared area and height of forest cover, were extremely favorable.

FOREST COVER

Cleared land is less desirable than forested land. Tall forests are superior to low forest cover. This is related to the damaging effects of both wind and sun. With adequate forest protection, a slope actually receives more snow as well as retaining it for a longer period of time.

SUITABLE SOIL

Land which is rocky or filled with springs may make development difficult or impossible. Soil conditions should support a good grass turf on ski slopes; have adequate drainage for good drive and parking area construction; and be suited to good building construction.

OTHER FACTORS

Sources of Water. When selecting a location for any winter sports business, it is essential to investigate sources of water. Water will be needed for the many services at the central shelter, such as the snack bar, first aid, and rest rooms. If snow-making equipment is contemplated, quantities of water in excess of 80 gallons-per-minute may be needed.

Electrical power supply. Minimum light and water pump service can be supplied by a generator

on the site, but the business will be limited severely without "high-line" power.

Telephone service to the site. Communication with the nearby community and its many business places is needed. Safety dictates communication with medical and hospital services. Reservations and other aspects of the operation of the business are carried on much more efficiently by telephone.

Professional guidance is helpful in selecting locations. Expert help on topography, soils, forests, climatology, and deep rock geology can save thousands of dollars for the investor in winter sports facilities. Professional assistance from landscape architects, architects, and engineers may avoid poor site selection and development.

CHECK THE MARKET AND ACCESS TO THE AREA

In contrast to the distribution of manufactured products to the consumer, winter sports businesses depend upon the customers coming to the areas. Therefore, **the number of persons interested in winter sports, their ability to pay for services, and the means of transporting them to the areas** become important when considering the location of new businesses.

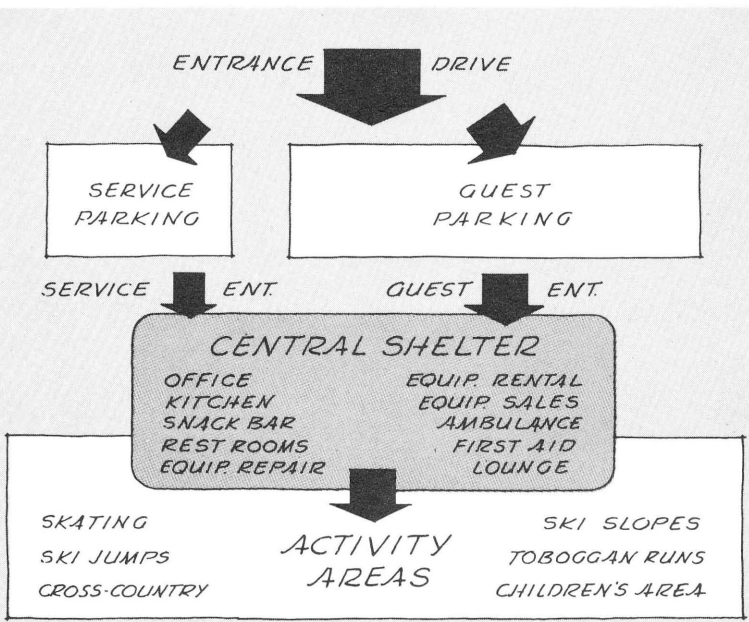


Fig. 3. An area is easier and safer to use if the layout prevents scattering by directing the flow of traffic in an orderly manner.

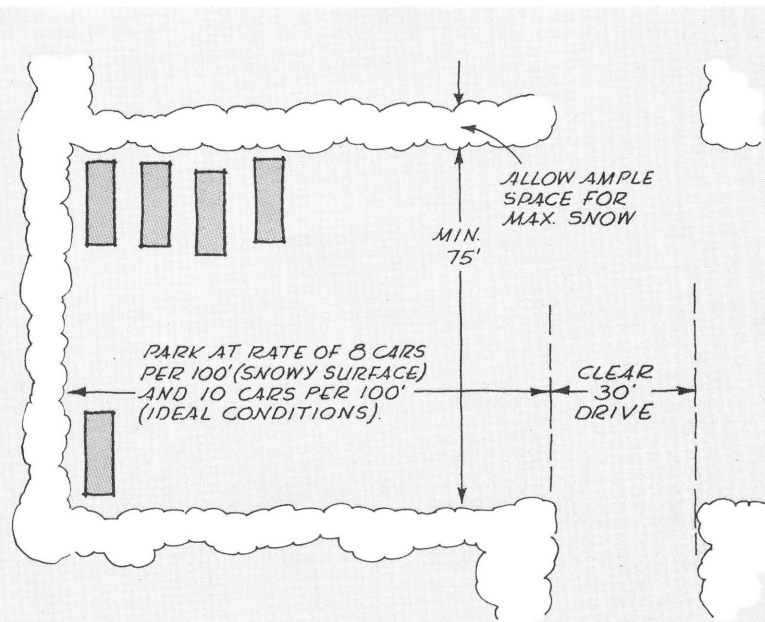


Fig. 4. Allow ample room for parking. Windrows of snow can act as barriers. Consider drainage to prevent icy parking after thawing and freezing.

While no precise prediction of future popularity can be made, present trends indicate that young people dominate the winter sports market. The majority of participants are from 15 to 34 years of age. Other important age groups are teen-age children and winter vacationing families, including pre-school children and adults over 40. From the potential market standpoint, the future of the winter sports business looks bright considering that those in the 15 to 34 age group in the U. S. may number 61 million by 1970, compared to 46 million today.

Logically, the younger age groups are not able to spend as much as those who are older and have higher incomes. However, the high patronage in the younger age group indicates a willingness to pay for transportation and basic tow fees. The popularity of more complete meal service, high quality rooms, and extra services seems to parallel increases in incomes.

The automobile is the dominant means of transportation. Therefore, in selecting a new location, the operator must consider highway routes, highway quality, and highway upkeep in winter. The primary market for winter sports patronage in Michigan lies in the metropolitan-industrial belt from northern Illinois through northern Ohio. Good highway access is also needed for those who come to winter sports areas by bus.

Ski trains, popular in eastern states, do not appear to be popular in the lower peninsula but do contribute to business in the Upper Peninsula. Air travel to winter sports areas is complicated by ground travel at each terminal, the handling of cumbersome equipment, and adverse flying conditions.

INVESTIGATE NEARBY SERVICES

So far, only a small number of resorts provide entertainment, complete food service, and lodging at the winter sports area. The majority are highly dependent upon the nearby community for these services.

Therefore, in selecting a location it becomes important to survey the number and quality of establishments providing entertainment, beverages, food service, and lodging. These services are important to skiers and other winter sports enthusiasts.

In addition to the commercial services, those provided by agencies and organizations should be reviewed. A more favorable location is one near a community with good street upkeep; high standards of sanitation; active chamber of commerce; active youth organizations; good medical and hospital services; and general community support of winter resorting.

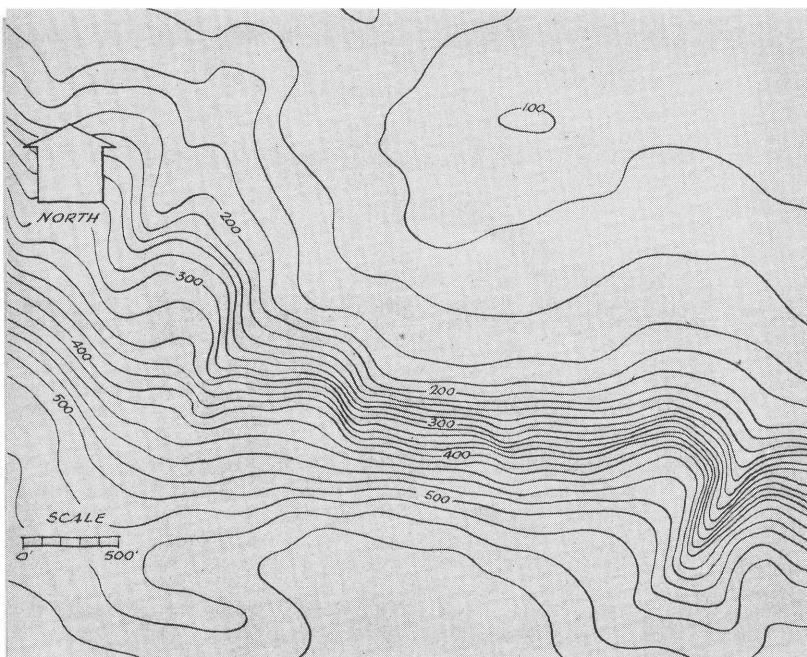


Fig. 5. A typical contour map, helpful in determining percent slope, orientation to sun and wind, and amount of land for parking, buildings, and activities.

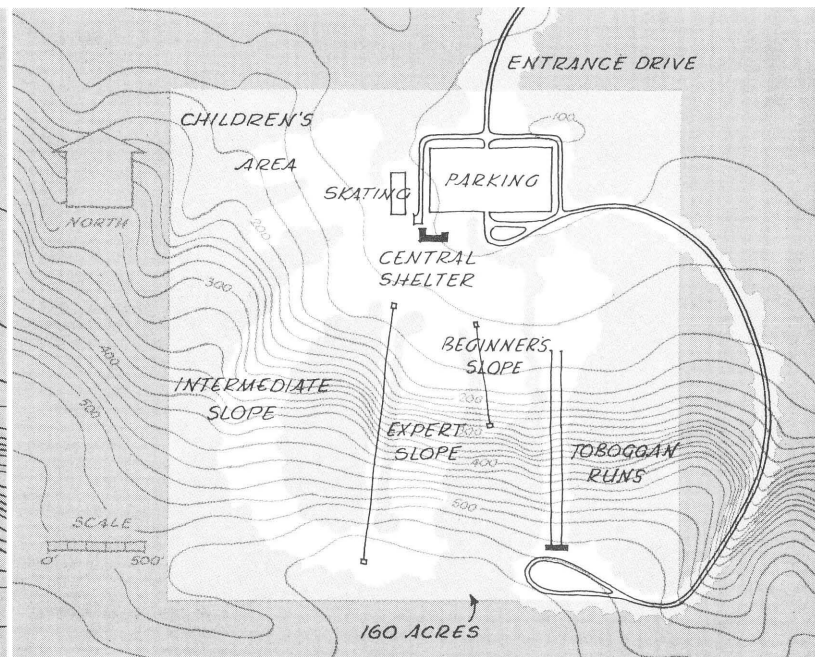


Fig. 6. A site plan of a small winter sports center. Ample land must be obtained for parking, buildings, sports activities, and future expansion.

DEVELOP A PROSPECTUS

The minimum investment in a winter sports area nowadays is about \$100,000. Before you seek a mortgage or begin spending such a sum of money, you should have a clear idea of the entire project you hope to develop. Taking the time to prepare a well-organized and complete report on your proposed project is worthwhile for many reasons.

First, in obtaining the facts for others to read and understand you will have much better knowledge of your own project. Sometimes, our enthusiasm tends to bring us to conclusions which are not founded in fact.

Next, without a prospectus, you will find it

difficult to describe your intentions to others. It is much easier to say to a builder, banker, or friend, "take this report home with you and look it over. It explains what I have in mind."

Furthermore, it gives all readers the impression that you are a good businessman and capable of management because you can present your ideas clearly and in an orderly fashion.

You are urged to develop a prospectus on the following outline:

Analysis of the Location and Site
Proposed Layout of Development
Proposed Buildings and other Construction
Estimated Costs and Returns
Qualifications of Owner-Manager

Layout Suggestions

DESIGN AND CONSTRUCTION

- ✓ The area should be easy and convenient for the guest to use.
- ✓ The layout should make the area easy to maintain.
- ✓ The layout should be free from safety hazards.
- ✓ When properly done, the layout should be attractive and interesting.
- ✓ The layout should make best use of the natural site advantages.

- ✓ Obtain the assistance of a professional skier and a landscape architect.
- ✓ See Fig. 3 for a typical functional diagram.
- ✓ See Fig. 6 for a typical layout of a winter sports area.

ENTRANCE, DRIVES AND PARKING

- ✓ Entrance should be clearly marked and provide easy access from main highway.

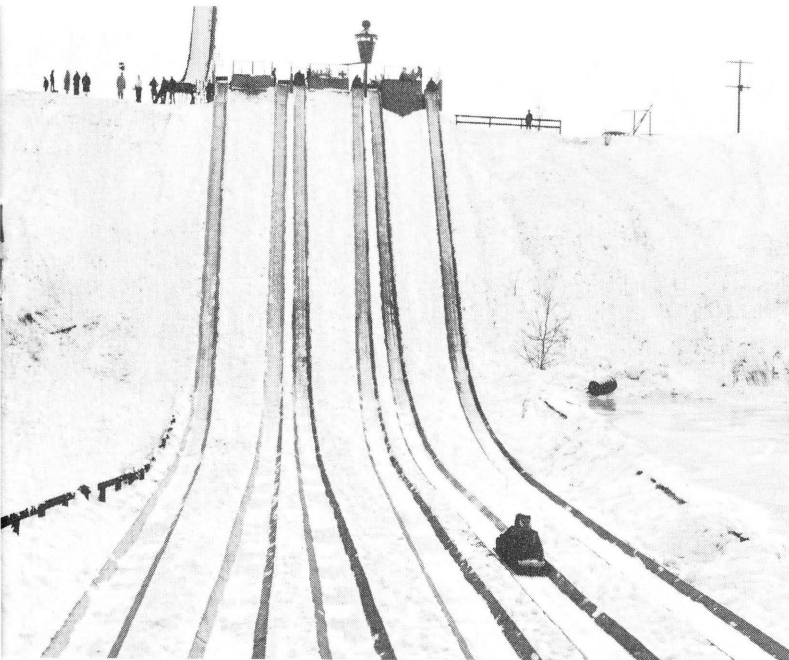


Fig. 7. Several parallel runs, using concrete for basic construction. Maximum speed is assured by iced chute, sprayed nightly during season.



Fig. 8. Typical toboggan run with steel rail sides. Note straight route and absence of dips or bumps. Proper construction and layout are needed for safety.

- ✓ Follow specific rules of size, shape, and design of drives and parking (see Fig. 4).
- ✓ Avoid hazardous curves or grades.
- ✓ Separate service drive and parking from public drive and parking.
- ✓ Consider drainage to avoid icy drives and parking.
- ✓ Direct all new guests to single control point (entrance of shelter).

BUILDING ARRANGEMENT

- ✓ Should make best use of the site.
- ✓ Building placement should allow for expansion of both buildings and site development.
- ✓ Guest should obtain good first impression and find his way around easily.
- ✓ Grouping should be functional for the manager.

ACTIVITY AREAS

SKI SLOPES

- ✓ Beginners' area: not to exceed 20% slope; slow tow for practice; isolated from experienced skiers.
- ✓ Intermediate area: 25% to 50% on steeper portions of slope; 5% to 15% on lower or out-run; about 150 feet cleared width; reasonably direct route down.
- ✓ Expert area: 60% or more for added challenge; 20% to 40% slope on major portion of slope;

minimum of 75-foot cleared width; more circuitous route down is permissible.

- ✓ Slopes graded to avoid bowls, dips, bumps; edges of clearing bordered with shrubs; good grass turf on slopes (kept cut in summer).
- ✓ Screen of plantings at base to protect skiers waiting for tow or lift.
- ✓ Grading down toward the hill at beginning of tow so skier is not jerked from a standstill.

SKI JUMPING

- ✓ Competitive jumps follow specific rules of layout and design (contact the Ski Hill Engineering Committee of the NSA).³
- ✓ Provide ample space for spectators — both standing room and parking.
- ✓ Consult specialists for design of smaller non-competitive jumps.

CROSS-COUNTRY TRAILS

- ✓ Not less than ten feet wide.
- ✓ Slope not to exceed 10%.
- ✓ Should not exceed two miles in length.
- ✓ Consider warming shelter, intercom at end of trail.

OTHER ACTIVITIES

✓ Toboggan runs: layout, design, and construction must be accurate and smooth to avoid hazards (see Figs. 7 and 8); isolate from skiing or other activ-

³Edmund Couch, Jr., Chairman, Ski Hill Engineering Committee, National Ski Association, 4 Virginia Hills Ave., Alexandria, Virginia.



Fig. 9. Rope tows are very popular because of capacity, ease of installation and low cost. Proper installation reduces rope breakage.



Fig. 10. A positive power cut-off device is an absolute necessity for all rope tows. Ample area for landing ahead of safety cut-off is needed.

ities; uphill access and toboggan return by truck or caterpillar vehicle.

- ✓ Skating: on any level land; about 85' x 200' desirable size for hockey and exhibition skating; wood-floored shelter for warming, snacks, first aid adjacent to skating rink.
- ✓ Children's area: gentler slopes for saucers, sleds, or "cardboard" slides (see Fig. 14); isolated from ski slopes and toboggans for safety.
- ✓ Ice fishing: an attraction in itself but seldom patronized by those participating in skiing, skating, or tobogganing.
- ✓ Sleigh Rides, Snowshoe Trails, Viewing Wildlife: supplementary activities which require their own special land characteristics.
- ✓ Swimming Pool: an added attraction being used by some; most satisfactory when enclosed and heated; must be built to rigid health requirements.

UPHILL EQUIPMENT

Your selection of uphill equipment will depend upon: initial cost; cost of operation; convenience; site conditions; and capacity. No one type is best for all conditions.

ROPE TOW

- ✓ Popular because of low first cost; ease of installation; capacity (see Fig. 9).
- ✓ Breakage most often caused by: improper

splicing; excessive surface wear caused by dragging rope; misalignment of sheaves or sheaves too small; excessive tension; and mildew, resulting from improper storage.

- ✓ Long rope tows are fatiguing. Maximum is 1000'.
- ✓ Tow speeds are normally 15 mph; may be increased to 20 mph on steep slopes; 10 mph on beginners' tow.
- ✓ Power at top of slope is preferred.
- ✓ Electric motor power is preferred, but gasoline engine may suffice if properly installed and maintained.
- ✓ All power equipment must have safety controls and positive cut-off (see Fig. 10).

PLATTER PULL

- ✓ Uses stock manufactured parts, but is designed to suit specific needs of lift and capacity (see Fig. 11).
- ✓ Higher cost than rope tow, but has less frequent breakdowns.
- ✓ Is flexible in capacity, because platters are not fixed on cable.

T-BAR

- ✓ Higher investment, but greater capacity than Platter Pull (see Fig. 12).
- ✓ Can be purchased with option to replace T-bars with chairs.
- ✓ Well suited to longer and higher slopes.



Fig. 11. Platter Pull. A durable type; takes up one skier at a time. Capacity can be adjusted to need.



Fig. 12. T-bar. A durable type which takes up two at a time. T-bars can be replaced with chairs.



Fig. 13. Chair Lift. Deluxe uphill equipment, best suited to long and steep slopes.

CHAIR LIFT

- ✓ Deluxe uphill transportation (see Fig. 13).
- ✓ Most costly of all types.
- ✓ Skier has no contact with the ground; hence no accidents from this cause.
- ✓ Capacity not as great as other types.

SNOW-MAKING EQUIPMENT

The reasons given for the use of snow-making equipment are: unusual wear on ski slopes; unseasonably small amount of snowfall; favorable temperature conditions but normally low amount of snowfall. In any case, the cost of installation and operation of equipment must be justified by increased volume of business (see Fig. 15).

- ✓ Equipment now uses great amounts of water and compressed air. Example: 80 gpm at 50-65 psi, together with air at 1,000 cfm required to cover area 100' x 1000' with 3" of wet snow or 6-8" light snow.
- ✓ Air temperatures usually must be below 25°F.
- ✓ Consider layout of distribution piping and placement of equipment when making layout of slopes.

LIGHTING

- ✓ Minimum grounds lighting needed around buildings, parking, entrance.
- ✓ Special layout of lighting required if sports areas are to be used at night. (Night use of

sports areas is controversial; investigate before doing.)

- ✓ Select equipment which will provide ample light for each purpose.
- ✓ Install equipment properly so that it is safe and eliminates glare.
- ✓ Use lamps and wiring of proper size.
- ✓ Use durable equipment—reduces early repair or replacement.

SIGNS

- ✓ Advertising Signs: number, size and placement depend upon your advertising budget; should have short, quickly read message; size of letter, color, style quickly read for distance and time of viewing.
- ✓ Informative Signs: whether such signs are directional, rules, or identifying, they should be simple, clear, brief, and properly placed.

COMMUNICATIONS

- ✓ Telephone service to central shelter essential.
- ✓ Intercom system between central shelter and outlying services (remote shelters, power houses for tows or lifts) depends upon distance and site conditions.
- ✓ Public address system essential. Used for announcements, safety precautions, control, and music during sports participation.
- ✓ Underground transmission for electrical power and communications preferred.



Fig. 14. A cardboard slide. Hillside is graded slightly and trough is iced in freezing weather. Children slide down on flattened boxes.



Fig. 15. In areas of inadequate natural snowfall, but proper temperatures, snow can be made on the site. Cost must be justified by increased business.

Building Suggestions

DESIGN AND CONSTRUCTION

- ✓ Obtain professional guidance on the design of all buildings.
- ✓ Study your own needs thoroughly before contacting your architect.
- ✓ No evidence is available to prove one architectural style more successful than another.
- ✓ All designs should be appealing to all who use the buildings, suited to snowy and icy conditions, and adapted to the setting.
- ✓ Special consideration should be given water supply, waste disposal, plumbing, ventilation, heating, and kitchen equipment.
- ✓ Make sure all building plans are: functional as well as attractive; subject to low upkeep; within your building budget; and such that future expansion will be easy (see Fig. 17).

THE CENTRAL SHELTER

- ✓ Entrance: should provide for tagging of all new guests; information on services available; rules of safety, and directions.
- ✓ Office: should include a business office with counter open to public; private office for manager; room for the Ski Patrol.
- ✓ The Lounge: should have sweeping view of ac-

tivity areas; decor which induces rest and relaxation; built to withstand rough usage; contain a large fireplace (see Fig. 16); easily accessible and yet not disturbed by traffic.

- ✓ Rest Rooms: ample number of fixtures for anticipated trade; accessible from both indoors as well as outdoors; built to withstand heavy use; easy to maintain in sanitary condition.
- ✓ Food Service: snack bar at one side of lounge is minimum; cafeteria or dining room service may be in demand; kitchen size, equipment and layout should be suited to type of service anticipated; consider service entrance and storage areas; obtain special help for layout.
- ✓ Equipment Rental: consider proper storage of equipment for daily rental; layout of area should facilitate quick service; amount and variety of rentals depend upon anticipated demand (in many areas, 20% of the guests use equipment rented at the site).
- ✓ Equipment Sales: opinions vary but some sales space seems desirable; amount of space depends upon volume of patronage and availability of equipment elsewhere.
- ✓ Equipment Repair: some space should be devoted to repair of ski and other winter sports equipment; usually located near equipment rental space.



Fig. 16. The lounge traditionally must have a fireplace. Suitable decor, durable furnishings, and adequate size are desirable features.



Fig. 17. All buildings should be attractive as well as functional, easily maintained, suitably sited, and easily expanded in future.

- ✓ First Aid: accessible from both inside and outside shelter; heated; hot and cold running water; equipped with usual needs for first aid; follow detailed recommendations in "Ski Patrol Manual."
- ✓ Ambulance: heated garage, housing station wagon or other suitable vehicle to serve as ambulance; readily accessible from first aid and service drive.

LODGING

- ✓ Young, unmarried (generally high school and college age): dormitory type housing with sep-

arate or open sleeping rooms for one sex and connected to a bath.

- ✓ Married couples and others: prefer private rooms, each with complete bath.
- ✓ Family groups: prefer private suites of rooms with bath.
- ✓ Before deciding upon building lodging, estimate the returns on the investment; existing motel and hotel facilities may be best solution.
- ✓ For year-around resort, consider the attachment of lodging to the central dining and lounge space.
- ✓ Consider the advantages of inside corridor access to guest rooms.

SUMMARY

Michigan has many natural advantages for winter sports activities.

Although the trial and error method has been used to date (and some very fine areas do exist) most operators agree that a more scientific approach should be made when expanding present facilities or developing new ones.

Before buying the land, one should consider: the type of business to enter; the most desirable site characteristics; the market and access to the area; the availability of other services nearby;

and prepare a complete prospectus of the business. This will avoid costly errors and will result in the development of only those lands best suited to this use.

When properly planned, the layout should make the area easy to use and maintain, be attractive in appearance, and allow for expansion of facilities.

All buildings should be functional as well as attractive; subject to low upkeep; within your building budget; and such that future expansion will be easy.

SEE ALSO

U. S. Geological Survey Maps of many areas of Michigan which indicate the topography with contour lines. Contact the Geological Survey Division, Michigan Department of Conservation, Lansing.

Ski Shop Bible. A directory of equipment and products relating to skiing. Published annually by the Ski Magazine, Hanover, New Hampshire.

Ski Patrol Manual. A guide for proper operation of ski areas; the National Ski Patrol System; safety considerations in layout, construction and equipment. Issued by the National Ski Association of America, 1130 16th St., Denver 2, Colorado.

Dependable, Economical Tows. A commercial bulletin, describing the design and construction of rope tow

equipment. Columbian Rope Company, Auburn, New York.

Ski Injuries — Their Prevention. A paper presented by Vernon D. E. Smith, M.D., F.A.C.S., St. Paul, Minnesota, and printed in *Bulletin, American College of Surgeons*, September - October, 1955.

Safety Standards for Ski Tows and Lifts. An excerpt from Forest Service Manual, Vol. 3, Sec. G. Prepared by the U. S. Forest Service, Washington, D.C.

The Skier, a midwest paper published at Corunna, Michigan.

Ski Magazine, a nationwide publication, Hanover, New Hampshire.

For further information, consult your county cooperative extension agent, or write to the Tourist and Resort Service, Kellogg Center, Michigan State University, East Lansing, Michigan.