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WINTER CONSTRUCTION

by

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Winter Construction

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Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June 1957

WINTERS IN CANADA are praised by many and cursed by many more. The severity of the weather varies from the mild damp regions of the Pacific coast to the harsh cold plains of the Prairie Provinces. But all regions in Canada have one thing in common—unemployment during the winter months. The construction industry is no exception to this general situation; in fact, the seasonal variation in employment in construction is greater than in any other major industry.

For Canada as a whole employment reaches a peak around the beginning of September, holds at a fairly high level through the fall, and then starts going downhill. This decline continues until about April when the seasonal upturn begins. What are the reasons for this annual variation in employment? The weather is, of course, one of the important factors. The Canadian farmer with the best will in the world cannot plant seed in February; Canadian seamen cannot sail the Great Lakes in mid-winter. There is another reason, however, for seasonal unemployment and that is customs and traditions like buying gifts at Christmas or new clothes at Easter (which is reflected in high employment in the retail trades) or starting to build a new house in the spring.

The most serious result of seasonal unemployment is the waste of manpower involved. Man-hours not used can never be regained. It is estimated that there are 250,000 Canadians seasonally unemployed each winter even in years of generally high employment. It is impossible to assess the actual cost of reduced output during the winter months, but in lost wages alone the figure would be many millions of dollars. Another important consideration is the annual cost of helping to maintain workers and their families who lost their jobs during the winter. In the months from December 1954 to April 1955 about $162,000,000 was paid out in unemployment insurance benefits, a large part of it to those seasonally unemployed. Unemployment affects all, because idle workers are not productive workers, and the loss in wages and purchasing power of those who are seasonally unemployed is felt by everyone.

Seasonal unemployment in the construction industry has been a national problem for only a relatively short time. Not long ago most construction work closed down in November and remained closed until April. Unemployment was not a serious problem because the good construction worker in summer became the top bush worker in winter. The construction industry has, however, undergone a "mechanical revolution" resulting in the development of many specialists to keep pace with the introduction of machines. These skilled men no longer find it easy to get another job when a construction project closes. In February 1957, 75,000 skilled construction workers were seeking employment. In fact, one-third of all unemployed at that time were skilled or unskilled construction workers. The profound effect of unemployment in the construction industry on the national economy is clearly evident.

The Federal Government has been vitally concerned with seasonal unemployment and in the past few years has been studying the problem in co-operation with employer and labour groups and with provincial governments. One of the results of the study made by the National Employment Committee was a recommendation to the Government that it should undertake a study of ways and means whereby the awarding of government contracts might be better timed to offset as much as possible the seasonal variations in construction activities.

In September 1955 in an address delivered before the Union of Nova Scotia Municipalities, the Minister of Public Works, the Honourable Robert Winters, announced the details of a Cabinet directive relating to winter construction. This directive ordered four specific steps to be taken in so far as they were practicable. These were:

(1) Government departments and agencies were to arrange their construction programs so that plans and specifications, tender calls, contract awards, and the various stages of actual construction would be timed to provide the maximum amount of winter work for the construction trades;

(2) alterations and repairs on buildings, houses and equipment owned by government agencies were to be planned so as to be carried out as far as practicable during the winter months;

(3) procurement programs were to be arranged where practicable to create the maximum amount of winter employment; and

(4) with the objective of keeping increased winter employment in mind, each department and agency concerned should, if necessary, adapt its financial arrangements, staffs, and other related matters in such a manner as to give effect to this directive.

Federal departments and agencies, although they spend sums running into hundreds of millions of dollars annually in the construction field, cannot alone solve the unemployment problem. The example already set by the Federal Government, if followed by governments at all levels and by private enterprise could really result in great progress.

In recognition of this fact, a Joint Committee on Wintertime Construction was formed in 1955 under the sponsorship of the Canadian Construction Association. This Committee represented the Canadian Chamber of Commerce, the Canadian Manufacturers' Association, the National House Builders Association, the Engineering Institute of Canada, the Royal Architectural Institute of Canada, the Canadian and Catholic Confederation of Labour, the Canadian Labour Congress, the Canadian Legion, as well as the sponsoring agency. In addition, representatives of the Federal Department of Labour and the National Research Council were associated with this Committee. The main work of this Committee to date has been to promote winter construction among its own member organizations by giving wide publicity to the advantages of maintaining a high level of employment throughout the year.

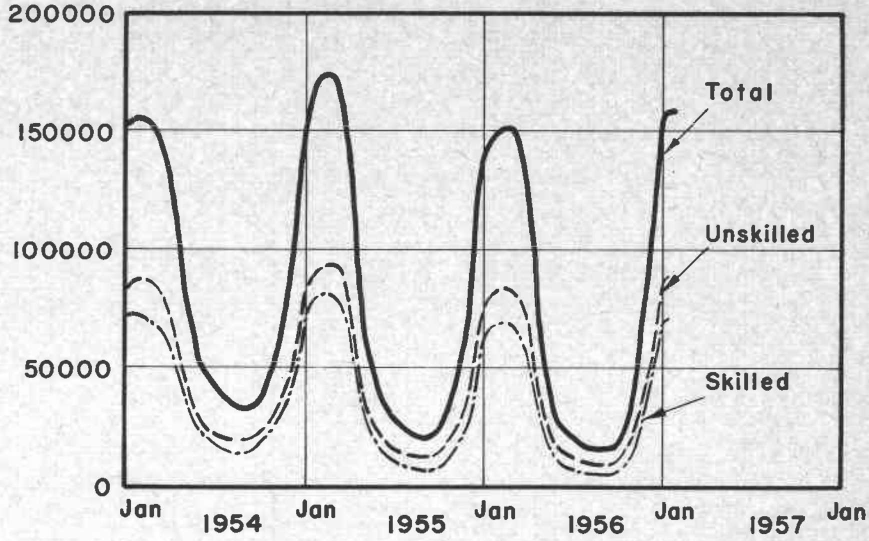


Fig. 1. Unemployment in the construction industry.

The Division of Building Research of the National Research Council has prepared a bulletin outlining techniques for winter construction[1] and a translation of a Swedish document on this same subject.[2] A study has been made of winter construction projects and some specific aspects of construction in winter, notably masonry construction, are being investigated. The study of construction techniques in other countries has been of particular interest particularly in the Scandinavian countries and in the U.S.S.R. where climatic conditions are similar in many respects.

In the translation of the Swedish bulletin on winter construction, the statement appears that state control of the building activity was enacted in order to spread work over the whole year by specifying times at which construction is to start, thus counteracting any unequal burden on the labour market. Details of this system were provided by Mr. Gil Schonning of the Department of Labour on his return from a visit to Scandinavian countries.[3]

In Norway and Sweden two major seasonal industries, construction and farming, dominate summer activity and two, forestry and fishing, are most active in the winter months. Although forestry and fishing always absorbed a sizable portion of the workers released from other seasonally fluctuating industries, statistics show that before the second World War winter unemployment was fairly high in both countries. During the postwar period, industrial expansion tended to outstrip available manpower resources and this led to inflationary pressures that have been reflected in the wage-price spiral of these countries. The high and rising level of investment for expansion of industrial capacity and services created a fast-growing construction industry somewhat out of proportion to the size of the countries. The inflationary burst of the construction industry in the summer added force to the already strong pressures on manpower and material generated by the rest of the economy. It was the development of these conditions that prompted Norway and Sweden to bring the construction industry under control.

The main technique introduced by the state with a view to stabilizing employment was the "permit" system. Permits to start work are now a prerequisite to almost all types of construction in Norway and Sweden. The immediate purpose of this scheme was to reduce summer activity and so reduce pressures on the manpower resources; a secondary aim was to stabilize employment in the building industry throughout the year. It was considered that when contractors had sufficient experience with planning year-round work, most of them would accept this new pattern of work as normal, even in the absence of control.

Building permits are issued by government agencies at the state, regional, or local level. Before authorization to begin building is granted, the contractor is required to show a time-table for the building, indicating the duration of work at each stage. If, on examination of the labour markets, the agency finds that sufficient tradesmen are not available for the work, or finds any other justifiable reasons for not allowing construction to proceed, it is empowered to withhold the granting of a permit to begin work. The agency is also authorized to interrupt work if the construction, in the judgment of the agency, should warrant it.

The permit system does not force a contractor to build in the winter, but it may prevent him from building in the summer thus meeting the immediate objective. Both Norway and Sweden have, however, announced national policies respecting year-round activity in construction. Thus a contractor who is granted a permit to build and then lays off large numbers of workers when winter sets in may find that the state agencies are unable to supply him with labour in the following spring and summer.

Apart from the direct approach through the permit system, the governments of the Scandinavian countries assist the construction industry both with respect to long-term capacity growth and to seasonal stability. Systematic planning seems to be the key factor in the attempts to level out construction employment. To assist the contractor in planning year-round work tripartite boards have been established at local, regional, and national levels with representation from the building unions, the contractor, and the state. Although the main function of these boards is to prevent undue pressures on the local labour markets, they also form the main pipeline of communication from research institutions to contractors, and to the public, on new techniques and information about materials.

Research appears to receive strong emphasis in the Scandinavian countries. At present, work is being done by agencies associated with the Ministries of Labour and Housing to determine which construction activities can only be done in summer and which can be done in winter. For example, a study is being conducted in Norway with a view to providing a list of road building and railway maintenance operations that could be done in the winter but that are now being done in the summer.

To utilize more fully the scarce manpower resources, various devices were introduced to stimulate greater labour mobility. The state undertook to cover workers' expenses of moving from place to place and to provide them with accommodation. An educational program was established designed to make the public and the builders aware of the problems and possibilities of winter construction and to disseminate information from research organizations and professional people in the industry. It was found that published information was not widely read by those for whom it was intended and that a more direct approach through short courses and visits to construction sites was more effective.

A study made by the research department of the Swedish Building Trade Unions indicated that it is almost impossible to reduce the summer to winter decline in employment to less than 10 per cent. The problem of additional costs of winter construction has also been studied. It is admitted that a project carried out during the winter months will sometimes cost more, depending on the duration of the project. If it lasted for a year, little or no extra cost might accrue from carrying the project through without interruption. If it was begun in the fall and finished in the spring some extra costs were undoubtedly incurred. It was considered, however, that such matters could not be considered of any significance in comparison with what might happen to wages and prices if the volume of extra work now carried out in the winter were dumped on the already scarce resources available in the summer.

The climate of much of Scandinavia is similar to parts of Canada and it is not strange therefore to find that winter construction techniques are also similar. The requirements for winter concreting are much the same in both countries. Calcium chloride may be used in quantities up to 2 per cent by weight of the cement, forms are insulated to retain the heat in the concrete, and the concrete is heated when the temperature falls below 25°F. The ideal temperature for the concrete during the first three days is considered to be in the range 60°-68°F.

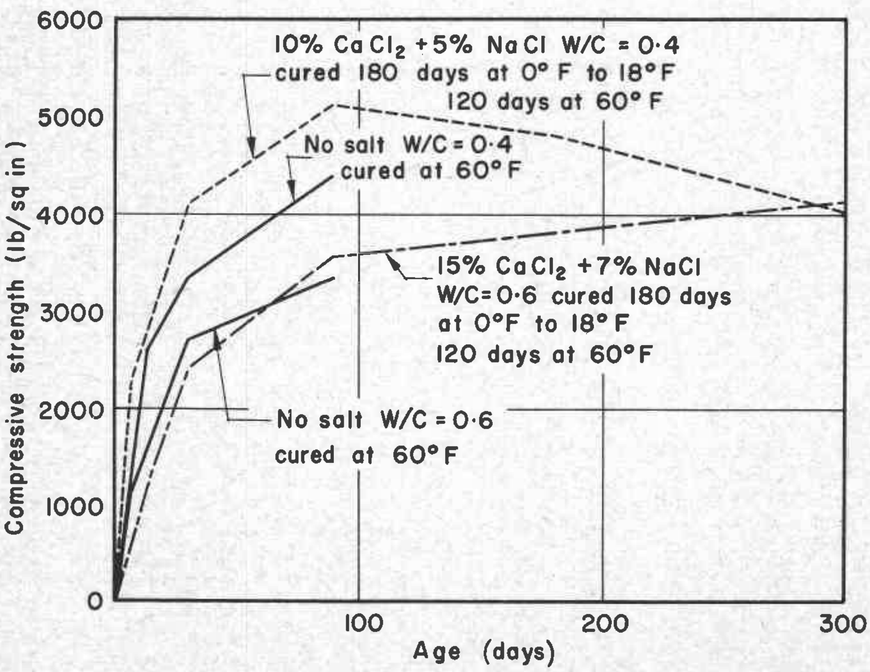
Owing to the fact that parts of Canada are subjected to extreme cold, concreting is done at much lower temperatures here than is normally the case in Scandinavia. For example, in Sweden it is considered possible to place concrete at temperatures down to 5°F., with protection, but contractors in Stockholm do not normally place concrete at this temperature. During the international symposium on winter concreting held in Copenhagen in February 1956, a visit was to be made to construction sites to see ready-mixed concrete being placed. The trip was called off, however, because the weather was too cold, the temperature being about 10°F., although by Canadian standards this is not low.

In the field of masonry construction, the requirements are less rigid than in Canada. Masonry work is allowed to proceed in Sweden and Norway at temperatures down to 14°F., when dry brick and warm mortar are used. In Finland, the minimum temperature for masonry construction is 21°F. and in Denmark 18°F. In all these countries, the work must be covered at the end of each working day to ensure that the walls are protected from rain or snow. Where night temperatures fall below 14°F., the walls are covered with reed mats. In Canada the requirements are that when the temperature falls below 40°F., the materials shall be heated to 40°F., and the masonry kept at 40°F., for 48 hours after being laid up.[4,5,6]

Precast cellular concretes are widely used in the Scandinavian countries where they were developed. These materials are often used as an outside facing for the load-bearing reinforced monolithic concrete used in residential and commercial buildings. By this method the concrete is not directly exposed to the elements. In coastal regions in Sweden and in most of Norway, the high incidence of wind-driven rains makes it necessary to place the insulating cellular concrete on the inside. In most of these areas, however, prefabricated concrete wall panels are used.

Prefabricated concrete wall, floor and roof panels as well as beams and columns are widely used, particularly in the northern parts of Scandinavia. In winter, particularly, this technique assumes great importance since most of the concreting can be carried out under shelter, the joints involving only a small volume of concrete. The joints are made by welding the reinforcement and covering it with concrete. The concrete is protected by small portable insulated

Fig. 2. Compressive strength of "cold concrete" cylinders.



shelters heated in many cases by light bulbs.

Sliding forms are also used on many multi-story buildings. The concrete is insulated by a layer of cellular concrete on the surface. This is considered a good method for winter concreting since the fresh concrete is protected from exposure and the enclosure is easy to heat. It is often used in conjunction with prefabricated floor elements.

Although there is a great deal of work being done in Europe to investigate many aspects of winter construction, the practical application of the work lags far behind these theoretical studies. This is partly due to lack of equipment and an apparent unwillingness on the part of labour to carry on under severe winter conditions. Certainly in Canada winter work goes on in greater relative volume under conditions more severe than those generally experienced in Europe.

No mention has yet been made of winter construction in the U.S.S.R. Practice in that country is of particular interest since the weather conditions in many parts of Russia can be duplicated in Canada. Many new and interesting techniques have been developed in the U.S.S.R. in an attempt to bring the volume and cost of winter construction to the same level as summer construction. Two of the more interesting developments—the use of cold concrete and the curing of concrete—will be described.

"Cold concreting" is the name which has been given to the Russian technique of using large quantities of calcium and sodium chloride in concrete placed in below-freezing weather. Calcium chloride, in quantities up to 2 per cent by weight of cement, has been widely used for years as an accelerator to increase the early strength of concrete placed in cold weather. In such cases, the anti-freeze property of the salt solution is ignored since the freezing point is lowered by only a few degrees. In the U.S.S.R., however, the chloride salts are used as an anti-freeze.

The amount of salt used is high, the maximum recommended being 20 per cent salt by weight of the water for use where minimum temperatures do not exceed —5°F. The ratio of calcium chloride to sodium chloride in the admixture depends on the air temperatures during curing and the time that the concrete can be left in the forms. But equal parts of NaCl and $CaCl_2$ are used where air temperatures are between +5°F. and —5°F.

The compressive strength of concrete made with large additions of chloride salts is high, and at temperatures between 0°F. and 18°F., design strengths are obtained in about 90 days. Where $CaCl_2$ alone or a mixture of salts high in $CaCl_2$ is used, quick setting and high early strength result. Later the rate of development of compressive strength slows down and in some cases an actual loss of strength occurs. When NaCl alone is used, the development of strength is slow at an early age, but at 270 to 300 days, the compressive strength exceeds that of the concrete with $CaCl_2$. Temperature has a marked effect on strength development, and if the air temperature is above freezing, very high strengths are recorded after only a few days.

The impermeability of cold concrete is higher than ordinary concrete, but its durability, as measured by resistance to freeze-thaw cycling, is low. Rapid corrosion of reinforcement occurs unless the concrete is dense and provides a cover of more than 1 inch. Well-graded high-quality aggregates are essential for reinforced concrete and the water-cement ratio should not exceed 0.5. Even then reinforced concrete should not be exposed to humidities in excess of 60 per cent.

Since 1952, when cold concrete was first used, until January 1956, 200,000 cubic yards had been placed in the U.S.S.R. It is used for retaining walls, canal structures, secondary roads, and building and machinery foundations. Concrete with large salt additions is not recommended, however, for the following conditions:

(*a*) reinforced concrete in areas where relative humidity exceeds 60 per cent;

(*b*) reinforced concrete subjected to alternate wetting and drying cycles;

(*c*) reinforced concrete where thorough compaction is difficult;

(*d*) reinforced concrete where cover is less than 1 inch;

(*e*) prestressed concrete;

(*f*) structures where good appearance is an essential requirement; and

(*g*) in massive structures with low surface area.

The properties of cold concrete as given above are all based on Russian reports.[7] There appears to be little information from other countries on concrete containing a high percentage of salts although at the recent annual meeting in Dallas of the American Concrete Institute it was reported that an American investigation had confirmed the low resistance of such concrete to freeze-thaw cycling.

Fig. 3. Winter construction in Edmonton.
Photograph: Goertz Studios

In the U.S.S.R., as in Canada, there has been great activity in hydro-electric power development. Since much of the concrete for the hydraulic structures must be placed during the winter months, a system has been developed for heating the surfaces of the concrete by electricity. Electrodes of ¼ inch to ⅜ inch round steel are placed at intervals of 8 to 12 inches on the inside of the forms and on adjacent concrete surfaces. The electrodes are heated by low voltage (50 to 90 volts) alternating current. The approximate time for electric heating is set as follows: for an air temperature of 15°F., 8 hours; for —5°F., 16 to 24 hours; for —20°F., 32 to 40 hours. Electricity is supplied by portable 50-kilowatt three-phase oil transformers and the consumption at —20°F., is 6 kilowatts per square yard of exposed surface.

The advantage of this system is that it permits the placing of concrete with a temperature of 40°F., without the danger of freezing at the edges and it does not require a heated structure around the concrete during the curing period. The top surfaces of the concrete blocks are not electrically heated but are covered and insulated. Unheated shelters are erected over the blocks only during prolonged periods at temperatures below 0°F.

In spite of the development of new materials and techniques of winter concreting, prefabrication is still widely used by Russian contractors, Residential, commercial, and many industrial buildings, are constructed the year round of prefabricated floor, wall, and roof panels, beams and columns. Most of these components are made of factory produced concrete which in winter can be placed and cured under optimum temperature conditions. The parts are erected by large cranes and the connections between components are made by welding the reinforcement and grouting the joints. High early strength concrete is often used and where necessary small portable heated shelters are used.

Although concrete is the chief material used in prefabricated components for buildings, brick masonry is also prefabricated into wall panels and columns, and lifted into place after curing by means of mobile cranes. In winter, the brick masonry is generally prepared in heated enclosures or protected by electrical heating. In some cases, however, the masonry is allowed to freeze as quickly as possible and the blocks develop sufficient strength by freezing to permit transporting them to the construction site and lifting them into position. Blocks prepared at freezing temperatures become fit for transportation within a few hours if the temperature is very low or within 10 to 15 hours at temperatures just below the freezing point. The blocks are placed on a thin layer of warm mortar which may have "anti-freeze" agents incorporated in the mix. These chemical admixtures are always used when it is known that the temperature will fluctuate around the freezing point or when a sudden thaw can be expected. Walls erected with frozen masonry blocks lose considerable strength when they thaw and some settlement occurs, often as much as 0.015 foot per foot in height. As the mortar hardens at temperatures above freezing, the walls gradually acquire the necessary strength and stability.

The details given above should not leave the impression that the Russians have developed new techniques which permit full-scale winter construction without the protection required in Canada. The quantity of "cold concrete" used to date is very small in terms of any large construction job. Electric heating of concrete is chiefly confined to some hydro-electric projects and the technique of freezing masonry blocks is still under study. Although the records show that much experimental work is in progress to improve these methods, they do indicate that something more can be done about cold weather construction. At the same time, it must be kept in mind that the laws of nature have not been repealed, and it is still as necessary as ever to recognize the hazards of winter construction.

Turning now to winter construction in Canada, there seems to be little doubt that this country leads the world in *per capita* volume of winter work. A study of practices in other parts of the world show that, with the possible exception of the U.S.S.R. and the United States, no country normally carries on winter construction under such severe weather as is experienced in the Prairies in winter. This is partly due to the climate of other countries since the U.S.S.R and North-western United States are the only areas where similar climatic conditions to those of Canada exist. Even in Canada, however, there are great variations in winter construction activity depending on local conditions. During the winter 1956/57, for example, a great deal of winter construction work was carried out in the Prairie Provinces. Contractors and engineers in this part of Canada face the most severe winter conditions in the country, although it must be admitted that in the Far North the severe weather lasts for a longer period. Western builders, while naturally proud of their ability to cope with the existing conditions, look with envy on contractors in other parts of Canada where weather conditions make winter construction more attractive. They are naturally surprised to find that most construction jobs in Vancouver were shut down for six weeks because of the severe local weather—snow on the ground and temperatures down to +10°F. to +20°F. This would almost indicate that local custom often decides what can be done in winter in any given area.

Canadian contractors have developed some ingenious methods of combating winter weather. Many types of hoarding are used including movable enclosed platforms suspended from outriggers on the roof of the building and laminated arch structures made from 1 x 4 lumber, reinforced kraft paper and polythene film. This latter type of enclosure was very successfully used with the lift-slab type of construction at the Winnipeg General Hospital.

The use of the lift-slab method of construction seems to be well suited to winter work. The floor and roof slabs, since they are all placed at ground level, can be protected by low cost structures which require little headroom and are easy to heat. When the slabs are cured they can

Fig. 4. Laminated wood arch enclosure.
Photograph: Brian Akins, "Techniques of Winter Construction"

be hoisted into place in temperatures as low as —20°F. Once the slabs are in place, the sides of the structure can be enclosed with canvas or polythene permitting work to continue without interruption.

Prefabricated wall, floor and roof panels are being specified on an increasing number of construction jobs in Canada, but in spite of the obvious advantages for winter work, the potential of this method of construction has not been fully exploited. Since these panels can be fabricated under controlled conditions, the weather at the site would have little effect on building progress. The use of prefabricated wall panels, in conjunction with the lift-slab method of construction, would seem to remove most of the difficulties of winter construction in many types of buildings.

It would be well to look briefly at some specific winter jobs in the various categories of construction to see what can be done. These may not be typical examples but they do show that "where there's a will, there's a way".

Ottawa house builder, Heinz Kroeger, found a circus tent the answer to his winter construction problem. The excavation was made in early February and the tent erected over the excavation. Four blower-type heaters maintained a temperature of 38° to 40°F., under the tent even when the outside temperature dropped to —20°F. Meanwhile, the foundation walls were placed, the frame erected, roof installed, brick veneer, stucco and plaster applied and even some outside painting was completed. Four weeks from the time the excavation was started, the tent was stripped and moved to a second house. The total extra cost was estimated by the builder at $300 to $500 but the advantages of continued work the year round were considered to be worth a great deal more.

In Winnipeg, the contract for a new bank building was awarded on 1 December 1955. The date of occupancy was set by the bank officials to be 15 March 1956. Thus, it was necessary to construct this building in its entirety during a period when very severe weather conditions are normal. By careful planning, the building was completed at an estimated additional cost of hoarding and heating of $500, or 1¼ per cent of the completed building cost.

In Hull, Quebec, two almost identical school buildings were erected by the same contractor, Mr. Raymond Brunet, one in summer and one in winter. The additional cost of the winter job was $4,800 or ¾ of 1 per cent of the total building cost. In addition, by starting in the late fall, the school was finished four months ahead of the original schedule.

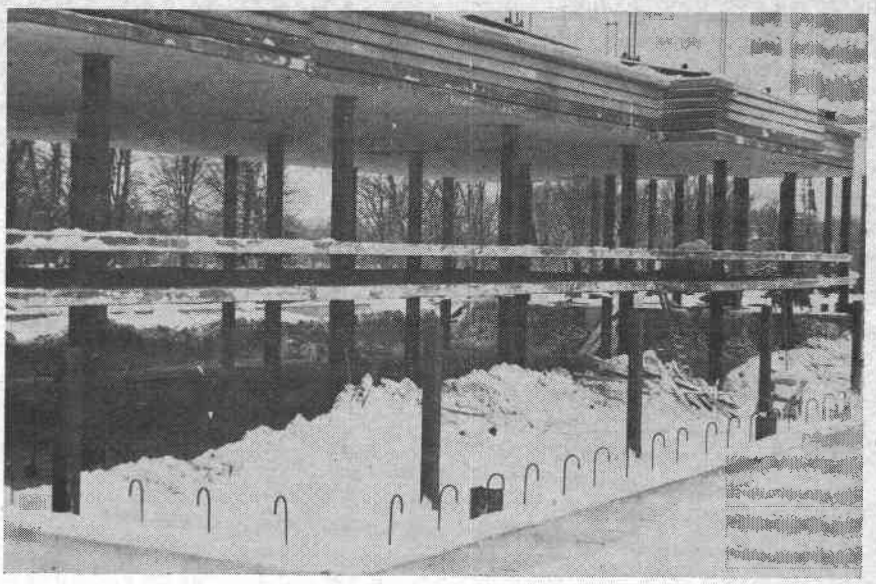


Fig. 5. Winter erection of a lift slab apartment block.
Photograph: Brian Akins, "Techniques of Winter Construction"

Many more examples could be given to show that all phases of construction, even excavation and outside painting, can be done in winter. There is always, however, an additional direct cost of winter construction since it is just not possible to enclose and heat a structure without incurring some expense. In addition, ready mix concrete costs more in winter and this can be a substantial item in some types of buildings. There are, however, many immediate compensations such as retention of skilled labour, good materials delivery, availability of subtrades, reduction in overhead, and early completion. Another factor that is not generally considered is the reduced labour costs of winter construction. Since 1934 there has been a steady increase in wages in the construction industry which, since the end of the second World War, has amounted to just under 8 per cent per year on the average. Material costs have also risen, although not to the same extent. That this factor may compensate for the added cost of winter construction is seen in cases where alternate tenders are called in the fall, one for an immediate start and the other for a spring start. In many such cases, the bids are the same.

Since it has been shown that winter construction is possible in Canada, and at an acceptable cost, what can be done to reduce unemployment in the construction industry during the winter months? The answer seems to be in convincing the owner that the quality of winter work is as high as summer work and that the additional direct cost is offset by many factors of which early occupancy and lower labour costs are but two. The Engineering Institute of Canada and the Royal Architectural Institute of Canada can do a great deal to promote winter construction, but only when the members of the two professional bodies are themselves convinced that it can be done and done properly. Whether this is the case can only be judged by the statements issued at the request of the Joint Committee on Wintertime Construction.

The E.I.C. stated: "Engineering projects are not shut down in winter when the cost of shutdown, including the interest on funds invested, exceeds the extra cost involved in winter construction.

"While there are exceptions, the quality of construction work carried out in winter in Canada need not suffer provided planning, supervision, and control of work is done by qualified engineers."

The statement of the R.A.I.C. read in part:

"It is felt that generally speaking wintertime construction is feasible provided that proper precautions are taken. It is recommended that before any decisions are made the proposals should be discussed with the architects of the buildings in the light of all circumstances such as climate, type of construction, site conditions, materials, costs, etc."

Contrast this with a statement made in the findings of a committee established by President Hoover in 1921 to study and report on seasonal operation in construction. It states:

"Summarizing the question of winter construction it may be stated without fear of contradiction that both from an engineering and quality standpoint any type of modern building construction can be accomplished, and most classes of engineering construction fully as well, in the winter months as at other seasons, if the proper protection during the progress of certain parts of the work is provided."

In the meantime, much valuable work is being done by local committees across the country, particularly in regard to the timing of maintenance work. This effort has been very successful and may well establish a permanent pattern. In addition, the trade journals are giving much publicity to winter construction programs and the techniques developed by individual builders to meet the challenge of local conditions.

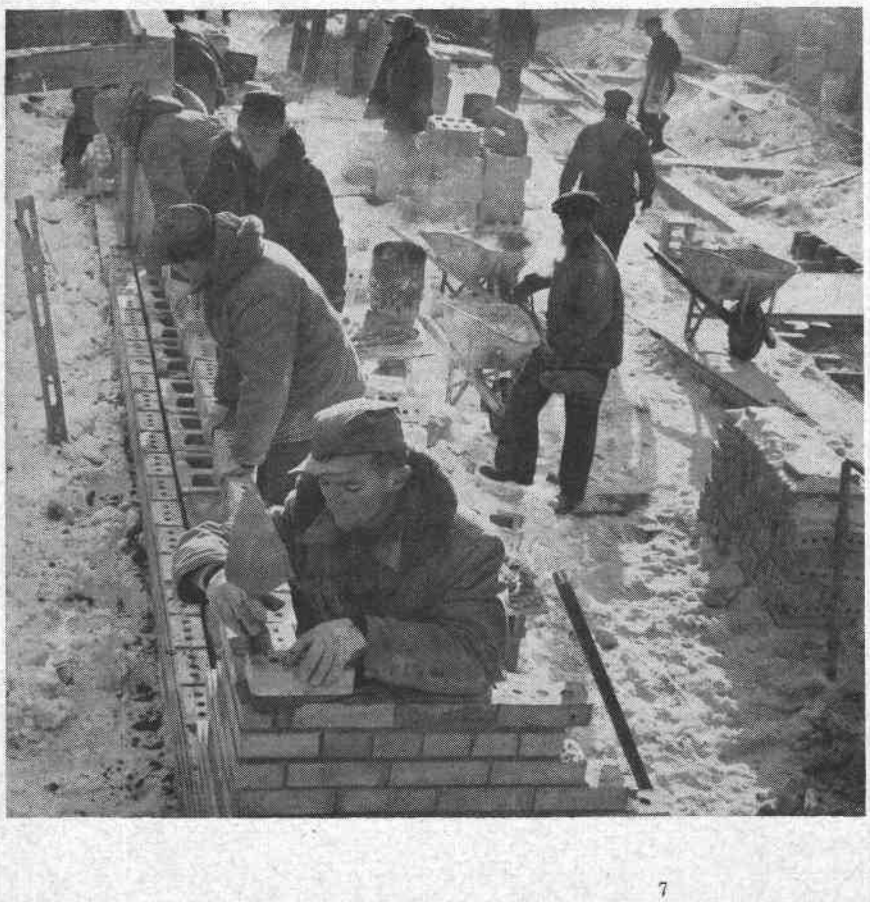
The Division of Building Research, besides issuing several bulletins on winter construction, is making studies of specific problems such as the use of masonry construction in winter. This study was started as the result of a request from a builder who pointed out the difficulties of complying with the existing regulations regarding the protection of masonry during cold weather. Investigation has shown that the existing regulations are based on the results of work done between 1923 and 1935, to determine the effect of low temperatures on concrete. The need for laboratory work to determine the effect of low temperatures not on concrete or on mortar, but on the combination of mortar and brick, is clearly indicated. This presents such a complex problem, however, that only after years of work will the answer be found.

In the meantime, where the regulations do not apply or where inspection is lax, brick masonry is being erected in winter under extremely adverse conditions with no apparent ill effects. There does seem to be some hope for the relaxation of existing requirements at least for non-load-bearing walls, but if such a change is to come soon it will probably be based on current practice in this and other countries rather than on laboratory investigations. In Europe, masonry construction is permitted at lower temperatures than in Canada and it may be possible to use the experience gained in these countries to adopt a more realistic approach to this problem.

Winter construction in Canada is now a well established practice and each year more and more people enjoy year-round employment in this great Canadian industry. There are still, however, great numbers of skilled and unskilled construction workers seeking employment during winter months. It is to the advantage of all Canadians to make every effort to ensure that seasonal unemployment is kept to a minimum. In the construction industry this should mean keeping the summer to winter decline to 10 per cent. That this can be done is shown by the fact that during the past five years 45 per cent of all construction work carried out by Defence Construction Limited was put in place each year in the six months between November and April.

One out of every five dollars spent in Canada today on end goods and services is spent on construction. This country cannot afford to shut down or even to slow down appreciably so vital an industry as construction. The so-called "construction season" is a term that should soon be out-dated. Canada must build the year round.

Fig. 6. Masonry construction in Winnipeg
Photograph: Gordon Aikman, Public Works in Canada



Acknowledgment

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A list of all publications of the Division of Building Research is available and may be obtained from the Publications Section, Division of Building Research, National Research Council, Ottawa, Canada.