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ORNAMENTAL AND BUILDING STONES, FORT CHIPEWYAN, ALBERTA

by

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PROJECT: ORNAMENTAL AND BUILDING STONES - FORT CHIPEWYAN, ALBERTA

I INTRODUCTION

Ornamental and building stones from crystalline (granitoid) rocks should ideally possess the following qualities -

(1) uniform, esthetically pleasing color;

(2) homogeneous and equant texture (no bands, layers or streaks of contrasting texture or mineralogy);

(3) be structurally massive (without joints) in outcrop or have only widely spaced joint sets;

(4) have little or no surface weathering effects;

(5) produce a suitably finished surface (polished, milled, flaked, etc.) to meet the specific and various architectural or engineering-constructional requirements.

Although a few granitoid ornamental and building stones make use of natural banding or layering to form a distinictive pattern as part of the general esthetic appeal, the majority of ornamental stones noted to date make use of the most homogeneous (texturally, structurally and mineralogically) rocks available.

II GEOLOGY

A. Field Program

With a minimum of available time and funds a small preliminary field program was undertaken from September 27 to 29 to ascertain whether or not the above five conditions might be achieved in rocks from the Fort Chipewyan district.

Reconnaissance mapping of the whole Precambrian Shield area surrounding Fort Chipewyan was carried out by the Research Council in 1970 and has provided

a suitable geological map upon which to base this preliminary building stone exploration. Two large granitic plutons (one red, one white-grey) close to the Fort Chipewyan settlement seemed to hold some promise from the 1970 survey and are favourably located with respect to water transportation. This present preliminary survey was restricted to selected, very small parts of these two plutons.

Initial survey efforts were directed towards eliminating unsuitable terrain within the plutons on the basis of the concentration of closely spaced master and major joints in the bedrock. Geophoto studies on a scale of 1 inch = 2,000 feet and 1 inch = 1,000 feet failed to yield sufficient detail for estimates or plots to be made of anything but the orientation of master joint systems. Consequently, this approach was abandoned.

In the field, an initial reconnaissance by low, slow-flying helicopter was aimed at the same objective, elimination of terrain with closely spaced joints and the consequent definition of local, promising target areas suitable for a follow-up ground check. Several such areas were designated for ground check close to Fort Chipewyan situated along the main water route leading from Lake Athabasca towards the Peace-Slave River system.

Three local sites in the Red Granite (1, 2, 3, see map) were examined on the ground, and a traverse on foot was made through a designated area (4) in the White Granite.

At these local sites the objective was to determine the variability of rock color, texture and small-scale structures on a quarry-sized scale and to measure the joint directions, distribution and frequency. Hand specimen-sized samples

were collected so as to indicate the maximum variation of the geologic characters present. Five larger specimens (1 cu. foot ±) were obtained for evaluation of color and textural characters in a large surface and to get some idea of the workability of the rocks in terms of a commercially scaled cutting and polishing operation.

B. General Comments on Red Granite

(i) Joints

(1) In the helicopter reconnaissance survey special attention was paid to the hilltop areas, close but not adjacent to the river channels, as it is felt that the latter tend to be associated with well jointed (if not faulted) zones. Outcrops along the river channels have been consistently the most closely jointed section of an outcrop, the well-jointed section commonly ranging up to widths of 10 to 30 feet away from the river.

(2) In the majority of cases (70% ±) the angles of intersection of two master or major joint sets are at 90° ± 15°. These joints tend to be steep, dipping at 90° ± 20° with only 10% of the joints dipping as low as 60°.

(3) The rectangular grid pattern of the principal channels in the Peace River delta area is obviously related to the rectangular joint and fault fracture systems.

(4) Very few multiple shear-surface zones were noted in the Red Granite i.e. joint fractures tend to occur as single surfaces, either continuously (as in most cases) or in an en echelon arrangement. The most pronounced

expression of a shear zone seen in areas away from the river banks amounted to three fracture surfaces over a width of six inches.

(5) The main joints (master plus major) i.e. the best defined in terms of length and joint surface separation, appear to belong to straight and fairly extensive joint systems. In most cases, two directions (sets) of well-defined joints are present. However, a third or fourth set may be poorly expressed as short, narrow, joint fractures which are rarely straight or repeated in a similar strike orientation, that is, other than for river bank outcrops. Close to the river, e.g. at the high school sample site at stop number 2, a steep river bank slope about 20 feet high, showed numerous flattish joints, repeated at 1 foot $\pm$ spacings.

(6) In less than 20% of the station observations flat-lying third and fourth order joints were noted. However, since steep outcrop faces of 4 feet or more in height were rarely observed this type of observation could be misleading. The observation may be a key to the successful development of a commercial quarry. Since there appears to be several places where two well-spaced master joints are indicated [and failing the presence of vertical intermediate hairline fractures, see note (7)] then the question of the existence of flat-lying third or fourth order joints could be decisive in determining the maximum size of joint-faced blocks that can be mined.

(7) Hammer pounding of joint-faced rock blocks (2 ft x 2 ft x 1 ft) to obtain very large specimens showed the presence of internal hairline fractures not visibly detected on either a weathered or a freshly broken rough surface. Are these hairline fractures related to surface weathering phenomena, to strain due to confining and load pressures which are gradually released during uncovering, or to (tectonic) shearing stresses? Will these hairline fractures diminish with depth from the present surface? If so, to what degree in the zone 20 to 30 feet beneath the present surface?

(8) Some well-defined exposed joint surfaces (e.g. 2 ft x 6 ft in area) fade out into seemingly unjointed rock. With hammer pounding - or in a building stone mining-manufacturing operation - would these visible joint faces be further extended and in fact be a partial explanation for phenomena described in note (7).

(ii) Mineralogy, texture and structure

(1) In summary, mineralogy, texture and structure are reasonably uniform throughout the pluton from a general petrological viewpoint. Closer examination at three sites revealed minor local variations in texture (grain size), very minor quartz gash veins, but still a virtually geologically homogeneous structure and mineralogy. It should be noted that cutters and polishers in the ornamental stone industry are far more critical of color and textural variations over small distances within a single rock slab than is carried out in a routine geological inspection.

(2) Mineralogy consists of pink to red feldspar, colorless to bluish grey quartz, and minor biotite (chloritic). There appears to be very little variation in mineral composition or in the overall color. That part of the pluton examined at stop number 1 reveals a pale red to pink feldspar color compared to the deeper color in other parts of the pluton.

(3) Texture for the most part (90%+) is of medium grain size. Two local areas (20 feet+ across) of slightly coarser grain size were noted. One pegmatite a few inches in width was noted at stop number 3 (sample 127-18) near the well-jointed zone towards the river on the east side of the study area. A local fine grained variation was noted at 5 out of 41 observation stations in the Red Granite pluton. None of these areas were large and do not appear to present a problem.

(4) Foliation-lineation is difficult to detect in outcrop as the granite is typically almost massive. Quartz tends to be elongated a little, and ferromagnesian mineral clustres may be rodlike, which is the main factor in megascopically defining the foliation-lineation texture.

(5) The granite is virtually without structure. In only one area (1 sq. foot in size) could gneissic banding be detected, and it showed flow features. If other flow folding is present the lack of dark minerals makes it difficult to be detected in outcrop or in hand specimen.

(6) The overall color effect of the rock is primarily influenced by the feldspar color; however, at a close-up viewing distance, measured in inches, quartz shows a color range from white to grey to colorless to grey blue.

(7) Color is particularly uniform over parts of the pluton traversed on foot, with the exception of the paler red area noted at stop number 1. Amongst 41 hand specimens collected from the Red Granite pluton, one (128-13) showed a distinctly deeper, almost chocolate-brick red coloration in a fairly fine-grained texture; this unusual condition is probably related to mild alteration (hematization of feldspar) commonly found adjacent to shear zones.

(8) The appearance of mafic mineral clustres in hand specimen varies over a limited range, depending on:

(a) the amount of mafic mineral, (2 to 5 per cent); and

(b) the size and shape of the mafic clustre, (clustres range generally from about 1/10 to 2/10 inches diameter, with a maximum of 1/2 inch), and the clustres may indicate a poorly defined foliation.

These mafic clustres are generally scattered and distributed fairly evenly throughout the rock. Locally, in only 3 specimens out of 41, the mafic clustres are distinctly streaky to lineated.

(9) Weathered zones beneath the glacially polished outcrop surfaces are almost negligible, ranging from a maximum of one inch to essentially zero in thickness.

(10) Small gash quartz veins provide a very minor structural and mineralogical irregularity. In a cumulative detailed traverse distance of over 1,000 feet, only three gash quartz veins up to 2 inches wide and 1 1/2 feet long were observed.

C. General Comments on White Granite

On the whole, the White Granite appears more variable than the Red Granite in terms of mineralogy, texture and small-scale structures.

(i) Joints

(1) This rock has a varied metamorphic foliation, but wherever defined it controls the directions of the master and major joints. One of these joint sets parallels the foliation direction and the other lies in a direction at 90° ± 20° from the foliation. Third and fourth order joint sets did not have an obvious orientation direction related to foliation.

(2) The better developed the rock foliation (probably related to amount of biotite) the greater the number of joints parallel to the foliation. As these joints get more closely spaced they may locally resemble a weak shear zone.

(3) Foliation-controlled joints intersecting other perpendicular joint faces, have been traced continuously down dip for up to 10 feet at a constant dip angle.

(4) The second major joint direction (perpendicular to the foliation) has generally widely spaced joints (2 to 4 feet) but which are locally closer to produce slabs from 6 inches to 1 foot thick.

(5) Some large areas, several hundreds of feet across, appear to be blocky jointed from the air and are possibly suitable for an ornamental-building stone industry if the problem of hairline fractures (mentioned under Red Granite) and foliation splitting remains insignificant.

(6) One notable blocky-jointed area occurs at sample site 132-23, some 50 to 200 feet north of the Rivière des Rochers bank. A detailed examination of the site should be made at a later date if other factors prove encouraging for the continued development of this project.

(ii) Mineralogy, Texture and Structure

(1) Mineralogy consists principally of white feldspar and grey quartz, with 2%$\pm$ mafic minerals - chloritic biotite, minor garnet, and rare sulphide.

(2) There are two distinct textures in the White Granite pluton:

(a) an equant, massive, medium-grained rock with few, scattered, large mafic mineral aggregates (132-10, 12); and

(b) a white feldspar megacrystic, foliated, medium-grained rock, with mafic minerals dispersed fairly uniformly throughout the rock generally (132-2, 5, 17).

(2a) Although the predominant character of the texture is massive, a faint foliation may be expressed in the elongation of quartz grains and possibly as a rare elongation of a mafic mineral aggregation. This textural type of White Granite should be generally less prone to the development of numerous foliation joint surfaces than the 2b type. The areal extent of the equant texture (2a) within the pluton, the shape and size of the individual "masses," are not known at present, and would require a more detailed study than time allowed on the initial preliminary survey. The textural character of type 2a is fairly homogeneous and gives a pleasing "clean" white over-all appearance dotted with irregularly shaped dark,

mafic mineral patches from 1/2 to 1 inch in diameter.

(2b) The megacrysts and foliation form the predominant characters of this textural type. Numerous white feldspar megacrysts from 2/10 to 4/10 inches long typically make up 25 to 35% of the rock and together with rare feldspar megacrysts from 3/4 to 1 1/2 inches long are enclosed within a medium-grained foliated matrix. The feldspar megacrysts are parallel to sub-parallel aligned with the matrix. The over-all color impression is light grey to 'dirty' white, largely due to the abundant grey quartz and mafic minerals dispersed throughout the matrix.

(3) Textural varieties intermediate between 2a and 2b commonly exist, and in such cases the white feldspar megacrysts are poorly defined enclosed in a medium to coarsely grained matrix that is crudely foliated.

(4) Other textural variations include (a) quartz-white feldspar pegmatites (feldspars of 1 inch diameter), the shape and boundaries of the bodies being indefinite and texturally diffuse with the enclosing rock; (b) rare areas of fine-grained, compact rock, as noted at the detailed collecting site (132-14 to 21).

(5) Mineralogical irregularities include rarely encountered small quartz veins, from 1 to 2 inches wide and up to 2 to 3 feet long.

D. Geological Generalizations and Summary

(1) The Red Granite pluton is the best evaluated of the two plutons and the three sample sites examined in detail should provide a fair, representative test at this stage of investigation.

(2) The White Granite pluton is not fairly represented in terms of data obtained from detailed ground investigations. Reconnaissance from the air, however, has shown that favorable blocky (master) jointed areas exist in this pluton close to the Rivière des Rochers outside of Wood Buffalo National Park.

(3) The main river channels in particular seem to be associated with zones of closely spaced master joints in the Precambrian outcrops along the banks.

(4) Not all sizes of fracture surfaces can be readily assessed in outcrop but they all have the same deleterious effect on a building stone operation. Narrow-gap fractures are difficult to impossible to see for the lichon growth, mineral stains and moss which occur on much of the outcrop surface. Medium-sized fracture separations (1/50 to 1/10 inches) are readily visible to the naked eye. Wider-gapped fractures may be seen as either a fracture separation or as an alignment of taller lichons, mosses and grasses, these latter being affected by the availability of water, rock debris, and organic matter in the fracture separation.

(5) The results of this preliminary survey have shown the Red Granite to be reasonably uniform in texture and color over quarry-sized areas (i.e. hundreds of feet) and at least the master and major joint spacings appear locally favorable for an ornamental-building stone operation. The White Granite shows greater variability in textural-structural character, but from the point of view of both textural and jointing qualities there appears to be adequate scope for continued exploration for suitable rock conditions

where quarry sites could be established in this granite. The 2b type textured rock tends to have a "muddy" or grey appearance compared to both the 2a texture and the "clean" look of the Red Granite.

(6) Information from machine operators at National Marble and Tile Ltd., who have cut and polished a total of five large blocks from the two plutons, suggests that the White Granite is unsuitable as an ornamental stone requiring high polish whereas selected parts of the Red Granite could be very acceptable and competitive on the commercial market in that form. The requirements for ornamental and building stone are very stringent, particular note being made of:

(a) complete absence of cracks on a finished surface;

(b) absolutely uniform and homogeneous (non-directive) texture to give an even mottled effect; grain size should be particularly uniform;

(c) mineralogy should be homogeneous, i.e. no streaks or clustres of minerals, and no veins;

(d) silicate rocks should be hard and take a good polish;

(i) White Granite: has been judged unsuitable for an ornamental stone requiring high polish on the basis of points (b), (c), and (d).

(ii) Red Granite: one sample out of three cut and polished blocks gave a perfect texture, good color and high polish. This sample (JG-71-128-18) was judged to be comparable in quality to the Quebec Granite (the source of virtually all ornamental granites in Canada) and almost as good as the Swedish Granite (which is the recognized standard on a worldwide basis).

The workability in cutting and polishing of the Chipewyan Red Granite is very good. Note should be made that future test blocks should be preferably 2 ft x 1 ft in area because of the large size of the commercial equipment.

It should be noted that the selection of Red Granite (and White Granite) blocks for cutting and polishing was almost geologically random - which therefore indicates considerable promise that an ore-body can be located within the pluton. The only guide used in the selection of large blocks in the field for commercial polishing was an area (close to the boat or plane) of sufficiently widely spaced joints to allow a one cubic foot sized mass to be obtained. Neither texture, color nor mineralogy were considered.

Unofficial passing comments by National Marble and Tile were that they would be willing to pay $60 to $100 per ton for 4 ft x 4 ft blocks of the quality Red Granite. It was also pointed out that both the Federal and Provincial Governments specify that native stone must be used in all of their building construction.

E. Recommendations

(1) It is felt that a more detailed, extensive, systematic field program has a very good chance to locate and define a site (ore body) in the Red Granite pluton suitable for the mining of commercial-grade ornamental-building stones. The White Granite is virtually a write-off as an ornamental-building stone requiring high-polish finishes; however, the massive-textured (2a type) variety should be investigated further to determine its workability

characteristics. Some enquiries should be made into other uses not requiring high-polish finishes that may provide alternate marketing possibilities.

(2) A more detailed reconnaissance should be attempted from the air over both the Red and possibly the Thesis Granites (see map) in search of minimum- and blocky-jointed areas. A limited rapid reconnaissance only has been made so far, along a section of the Rivière des Rochers and Channel Number 1. Consequently, very small portions of the three plutons have been examined critically and classed as unsuitable to date.

(3) Note the good overland access via the airport road (see map) to sections of the Thesis Granite making the latter a feasible target for future ornamental-building stone exploration. Very little attention was paid to this third pluton in the recent reconnaissance survey, and in fact no ground work was undertaken whatsoever as the focus was centred on the Red and White Granites.

(4) Subsequent to the next field program, and should those results appear favorable, it would be appropriate to call in some expertise from industry familiar in the exploration and development of ornamental and building stone, particularly as applied to granites.

III SOME BACKGROUND ECONOMIC DATA

A. Northern Transportation Limited

Tug and barge operators from Waterways, Alberta, north towards the Arctic Ocean. (10040 - 105 Street; phone 422-2161; Mr. Robinson, freight rate department.)

(1) In the Peace River delta area there are no alternate tug and barge routes to the presently used channel. Other waterways are either too shallow or too narrow for the commercially sized units now in use by Northern Transportation.

(2) Length of shipping season is approximately from May 10th to September 25th. In 1971 the last barge was scheduled to leave Fort Chipewyan southbound on October 1st.

(3) There are usually 12 round trips per shipping season.

(4) There are no special backhaul rates from Fort Chipewyan to the south. The standard freight rate varies with the volume in a shipment.

(5) The fifth class rate of 50¢ per 100 lbs. from Fort Chipewyan to Waterways applies to volumes up to 100 tons, equivalent to $10.00 per ton.

(6) Barge capacity in good water conditions is 400 tons; under low water conditions the load is about halved.

(7) Goods are pallet loaded; the barges carry a fork lift; present capacity is 3,000 lbs.

(8) Northern Transportation will load railway car lots at Waterways; less than railway car lots are handled through the Northern Alberta Railways agent.

(9) There is usually no charge for loading or transferring of freight at either Fort Chipewyan or Waterways. (However, a 10 ton chunk of rock could call for some special considerations.)

B. Northern Alberta Railways Limited

Operators between Edmonton and Waterways, Alberta.

(10012 - Jasper Avenue; phone 429-7221; Mr. Holtner - Freight Rate Department.)

(1) Freight moves from Waterways to the depot at Dunvegan Yards, Edmonton.

(2) Freight rates for a single piece of freight of various weights is given below:

Weight	Cost per 100 lbs.
150 lbs.	$4.75
300	$3.75
300 to 500	$2.59
500 to 1000	$2.30
1000 to 2000	$2.19
2000 to 5000	$2.04
5000 to 10000	$1.87

In carload lots (40 tons minimum) the freight rate is 57 cents per 100 lbs., with no restrictions as to dimension or number of pieces in the carload lot.

All above rates are for rough, unpolished rock surfaces.

(3) Loading and unloading charges: if less than carload lots (L.C.L.) then loading, unloading and delivery charges are all included in the above quoted rates, but for carload lots, the loading, unloading and delivery is extra.

C. Local Manufacture of Ornamental Natural Rock Slabs

Discussion with Mr. A. (Art) Milke, Manager, National Marble and Tile Ltd., 14360 - 125 Avenue; phone 454-2437.

No commercial cutting and polishing operation for facing stone is carried out in Edmonton. Cutting and polishing is only carried out locally by memorial stone manufacturers.

Orders for a particular job requiring rock facing are sent to the source quarry who cut and finish rock slabs according to the specifications of the job order. The slabs are then shipped to the distributor. Suppliers, such as National Marble and Tile Ltd., are buyers and distributors of rock slabs who sell products in the same condition as they are received. Little inventory is maintained and materials are ordered primarily as required by particular jobs.

Some standard rock slabs in 3 sizes are available on inventory specifically to make up the rectangular Ashlar pattern. Rock slabs are finished at the quarry site and supplied in 3 standard thicknesses - 2 1/4", 5" and 7 5/8".

Orders and sales appear to be made on a per ton basis.

There does not appear to be sufficient local business in ornamental-building stones to warrant the establishment and capital outlay for a commercial rock-cutting and polishing operation.

D. Production - Cost Elements

Mining

- supervisory staff - salaries (housing*)
- labour staff - salaries
- equipment (capital cost, maintenance)
  - depreciation - amortization
  - drilling or rock cutting equipment
  - loading of blocks (fork-lift)
  - truck (if access road built) to transport quarry staff and finished slabs (barge or bulldozer-sledge or bulldozer-trailer to move blocks to manufacturing plant)
- expendibles (explosives, pumps, small quarry gear)
- slab waste (irregular blocks in quarry; reject or defective slabs; finished slabs broken in transit).

Transportation (to Edmonton)

- barge (N.T.)
- railway (N.A.R.)
- truck (from N.A.R. depot).

Product Transfers

- barge to railway (N.T. to N.A.R.)
- railway to truck

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*About eleven Newstart Alberta Ltd. equipped trailers are unused and now available (?) in Chipewyan - future plans are not known.

Manufacturing

- supervisory staff and plant operators - salaries (housing*)
- capital cost of cutting and polishing equipment
- equipment depreciation - amortization
- building and utilities for manufacturing plant
- loading of finished slabs
- storage facilities

Sales and Distribution

- Edmonton-based office?

E. Canadian Production of Granite Ornamental and Building Stone

Year 1966 - the most recently reported official statistics.

All types of building and ornamental stone produced from quarries

= 261,573 tons valued at $12,898,069.

Granite building and ornamental stone produced from quarries

= 150,236 tons valued at $8,753,031.

Quebec granite production amounted to

= 142,891 tons valued at $8,446,913.

In short, Quebec produced about 95% of all granite quarried in Canada, in terms of both volume and value. Above figures are compiled from quarry data and represent tons sold from the quarries and the dollar value received by the quarry operators.

The production of granite throughout Canada has been recorded as follows:

Area	Short Tons	$ value
Atlantic provinces (N.S., N.B.)	1,192	148,303
Quebec	142,891	8,446,913
Ontario	2,647	52,815
Western provinces (Man., B.C.)	3,506	105,000
Total Canada	150,236	8,753,031

The average price (dollars per/short ton) of all categories of granite throughout Canada is as follows:

Area	1965	1966
Atlantic provinces (N.S., N.B.)	149.60	124.42
Quebec	58.11	59.11
Ontario	14.59	19.95
Western provinces (Man., B.C.)	20.00	29.95
Weighted average	55.42	58.26

Following is a brief description of the granites (which includes all igneous and metamorphic rocks) produced in Ontario, Manitoba and British Columbia.

Ontario

A salmon-pink, medium-grained granite is potentially available near Kenora at Vermilion Bay. A black anorthosite is available from the River Valley area north of Sturgeon Falls near North Bay. Rough building blocks are quarried near Parry

Sound from a multicoloured gneissic rock. Potential production of red granite is available in the Lyndhurst and Gananoque areas. Deposits of black and red granite along the north shore of Lake Superior are potential sources of dimension stone while a large massive red granite rock is produced north of Havelock.

Manitoba

A durable, red granite of good quality is being quarried in the Lac du Bonnet area, 70 miles northeast of Winnipeg. Deposits of grey granite east of Winnipeg near the Ontario border are potential suppliers of building stone for local use.

British Columbia

A light-grey and blue-grey, even-grained granite is potentially available from both Nelson Island and Granite Island. Also potentially available is an andesite that has been used in building construction in Victoria and Vancouver in the past.

F. Production Cost Estimates for Granite Ornamental and Building Stone

(Quarried at Fort Chipewyan and landed in Edmonton.)

(per ton basis)

Mining, open pit operation		$ 20.00
Transportation, barge	$ 10.00	
rail	11.40	
loading	3.60	
	$ 25.00	25.00
Equipment depreciation, maintenance, storage		15.00
		$ 60.00 Sub-total

Manufacture, finish other than polished,		
cutting, shaping	$ 30.00	
finishing	30.00	
	$ 60.00	$120.00/ton (finish other than polished)
Manufacture, polished,		
cutting, shaping	$ 40.00	
polishing	120.00	
	$150.00	$210.00/ton (polished finish)

G. Current Market Price Estimates for Granite Ornamental and Building Stone

(landed in Edmonton); based on information supplied by the office of the Chief Architect.

Unpolished Slabs (floors and walls) - supply only, not installation.

Floors, A.G.T. Building, 1970 $5.50 square foot

Walls, general $6.00 square foot

Per slab 4 ft x 5 ft x 4 ins thick = $6.00 x 20 = $120.00 per slab,

weighing 2/3 ton

Equivalent market price = $180.00 per ton

Polished Slabs (walls) - supply only, not installation

Per slab = 4 ft x 5 ft x 3 ins thick = 1/2 ton

At $8.00 per square foot; $8.00 x 20 = $160.00 per slab, equivalent to

$320.00 per ton

At $10.00 per square foot; $10.00 x 20 = $200.00 per slab, equivalent to

$400.00 per ton

At $12.00 per square foot; $12.00 x 20 = $240.00 per slab, equivalent to

$480.00 per ton

H. Simplified Gross Profit Margin Estimates (landed in Edmonton)

Unpolished Slabs

Market price - cost price (per ton)

$180.00 - $120.00 = $60.00 per ton

Polished Slabs

Market price - cost price (per ton)

$480.00 to $320.00 - $210.00 = $110.00 to $270.00 per ton

I. Some general thoughts re an Ornamental-Building Stone Operation at Fort Chipewyan

(1) If the Alberta Provincial Government should assist in this potential industrial development in the form of a Crown Corporation or sponsored Co-operative, for the purpose of competitively marketing a commercial rock product, then undoubtedly complaints and resistance will be forthcoming from competitors in varous sectors of this industry - i.e. mining, manufacturing and distributing.

(2) Operation of a quarry at Fort Chipewyan employing the indigenous peoples, at least at the outset, should take into consideration those times in the year when the native people take part in traditional activities such as big game hunting, fishing, and trapping.

(3) In view of the above (2) and the inclement winter conditons it would seem appropriate from the start to plan on an open-pit operation lasting about five months of the year - during the summertime period. Sufficient rough blocks could be quarried in that length of time to allow slabbing and

finishing to be carried on under cover on a year-round basis.

(4) Should a suitable quarry site be located inland away from navigable water, then a fairly inexpensive winter road might be a solution to moving rough quarried blocks to Fort Chipewyan. However, this mode of transportation would only be necessary if the route used by employees of the quarry during the summertime operation proved unsuitable.

(5) With continued technological success in the form of exploration and development of an ore body, and an assumed manufacturing capability in the production of a commercial-grade slab, some early assessment would need to be made of the potential immediate market. The scale of all technical planning, budget estimates, etc., for such an enterprise will hinge on that proportion of the available market into which sales can be reasonably projected.

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