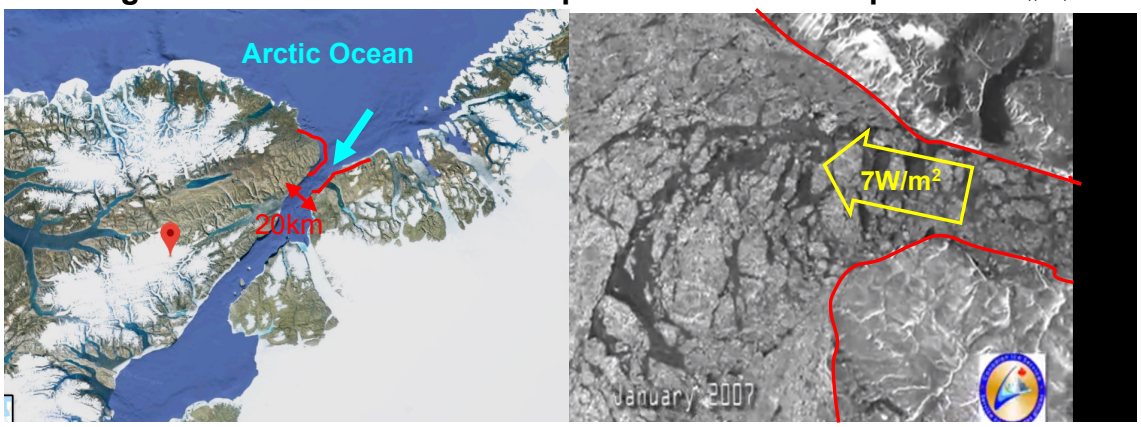
Blocking Nares Strait Gate to Intercept Methane Catastrophe. 2019/7/3,,25,8/1



Google Map https://www.youtube.com/watch?v=4Huhs1e2XKM

This is Nares Strait Inlet(width=20km),to where massive colder(water&ice)flow are coming in toward the outlet→Davis strait→Pacific Ocean.This acts deadly Arctic Warming by(～7W/m²?). Because something colder output=something warmer input.Now Arctic Warming by Heat Debt=4W/m² has been heading to massive Methane Eruption causing Global Extinction.

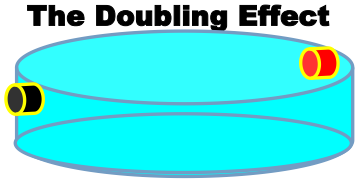
☞:Heat Debt=heat input－heat output (normalized by Arctic=1.41x10¹²m² in a year=3600sx24hx365d).

Then can you intercept the ocean flow at Nares Strait Inlet(width=20km)by Geo Engineering??!!. OFF outflow current could cause also to stop inflow heat the double effect !!

(1+1)x7W—4W＝10W/m² repayment would cool Arctic rapidly to recover the stability.

☞☞:0＝All inflow currents－All outflow currents.<ocean surface height must be constant>

The Doubling Effect



This is Arctic Pond with inlet and outlet for ocean current.
The surface height must be constant not to overflow.
If we off black outlet,then red inlet current must be reduced.
The both current act Arctic warming.What would happen !!!

PART Ⅰ:GATE BUILDING SCIENCE BASIS.

[１]：Ocean Current(sea water volume)Budget View<0＝inflows－outflows> !!!

This chapter proves the most important doubling effect in follows.

(1)Before 2007,flow in Ares strait did not occur,but it had been being closed.

Blocking the inlet ocean current may be to repay heat debt more than 4W/m² by At Once !.

Then intercepting output flow 0.80Sv may reduce input heat flow from Pacific and Atlantic ocean(0.80x10⁶m³/sx1000kg/m³x4.184kJ/kgKx3℃?＝10x10¹²TW＝7Wm²?.

This seemed too optimistic to believe even by author-himself.However the condition became more favorable in proceeding the verification.

☞:Thus,your task is to find and correct his mistakes !!

(2)**Arctic Ocean Current Budget**<0＝$S^{(+)}$inflows－$S^{(-)}$outflows;;＊Sv＝$10^6m^3/s$>

Arctic Mediterranean exchanges: a consistent volume budget and trends in transports from two decades of observations

https://www.ocean-sci.net/15/379/2019/os-15-379-2019.pdf

Surface inflow=$S^{(+)}$=9.1Sv	**Surface outflow**=$S^{(-)}$=3.3Sv	**THC outflow**=$S^{(-)}_{THC}$=5.8Sv
Bering strait=$S^{(+)}_{Be}$=0.9,	Nares strait=$S^{(-)}_{Ba}$=0.80?	**Themohaline Current**=5.8
Barents sea=$S^{(+)}_{Ba}$=8.0	Canadian AP=$S^{(-)}_{Ba}$=1.0?	Sink Current by density rise by sea surface cooling to volume shrinkage with salinity rise in ice freezing.This is colder downward current toward sea floor output.
Precipitation=$S^{(+)}_{P}$=0.2	Fram strait=$S^{(-)}_{Ba}$=1.5?	
Pulling in Current by THC,or compensation current by volume shrinkage by cooling	Outward Centrifugal Force Pressure by earth rotation. P=(2/3) ρ u^2.	

As for off Nares current,followings are decisive conclusion in this report.

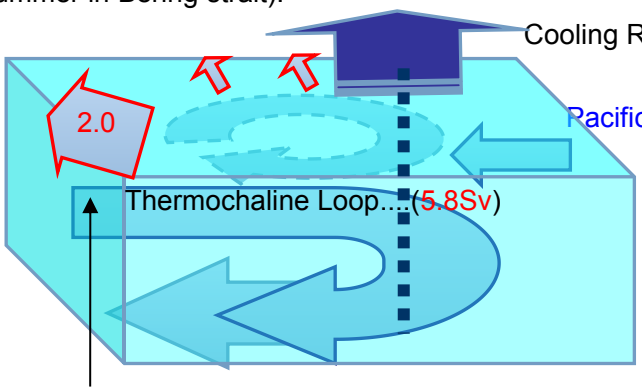
(3)**The Forces to Inflow and Outflow Current to Arctic.**

It is volume sensitive heat convection force and Coriolis force(gravity by earth rotation).

(a)**Surface In-Flows by Volume Shrinkage or Density Change.**

https://www.ocean-sci.net/15/379/2019/os-15-379-2019.pdf

This is sea surface height(volume shrinkage)sensitive flow due to fluid volume shrinkage. Sea Fig11,you could see downward Thermohaline Current(THC=5.8Sv) toward sea floor. THC is the most outflow current by 5.8Sv.This is is due to maximum density(-2℃,1.03Kg/m^3) of sea water downward flow .It is to pull in warmer Pacific current and Atlantic current at Bering Strait and Barents sea.It is remarkable phenomena that intensity of the current is stronger in winter and weaker in summer season(1.2Sv maximum in winter,0.4Sv minimum in summer in Bering strait).

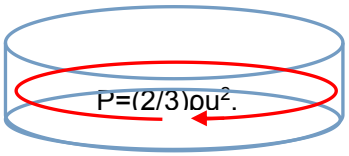


Atlantic inflow(8.0Sv)current at Barents sea

(b)**Surface Out-Flow by Outward Pressure by Earth Rotation.**

This could not be convection force,because surface current is less density,which never go down output current.The left possibility is gravity due to earth Rotation with north pole center.This rotational current generates outward pressure P=(2/3)ρu^2(see APPENDIX-2). This causes outward strait current at Fram,Nares and Canadian Archipelago straits.

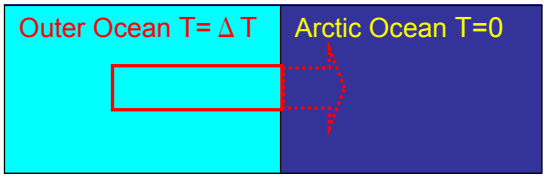
*Sea surface rise h by year off Nares 0.8Sv<Arctic ocean area S=14,056,000km^2>.
Arctic ocean depth=1,038m; ;;Arctic ocean volme V_S=1,46x10^{16}m^3,
V_1=1Svx3600x24x365=3.15x10^{13}m^3,.→ h=V_1/S=2.24m/year＝0.6cm/day.
Remind Tsunami propagation in which sea surface is pull up temporary,Off the strait may transiently cause Tsunami effect toward widely Arctic ocean gates.Then outward flow may increase for a while by sea surface height rise.In stationary,chronicle deficit of outflow is to change nothing surface outflow because <sea surface height and outward pressure P=(2/3)u^2 >is the same as before.Then off effect would not much change “u” in the massive Arctic rotational flow.Thus left possibility is volume change sensitive flow and reduce inflow (Berging and Barents)by 0.80Sv.This is to cause large heat input reduction in Arctic!!.



If Narrs strait flow(0.80Sv)was off,the mass conservation law is to find another path to outflow.Then note it never be outflow of THC、Similar Canadian Archipelago strait flow is dominated by P=(2/3)ρu^2,which could not largely be changed.

(4)0＝$S^{(+)}$－$S^{(-)}$－$S^{(-)}_{THC}$＝($S^{(+)}$－Δs)－($S^{(-)}$－Δs)－$S^{(-)}_{THC}$....<Δs=off current !>
Above (a)(b) are summarized as above relation the doubling effect=2Δs !!.

(5)Heat flow=J with sea water mass current＝S(m^3/s) with temperature change=ΔT.



J＝ΔTC_{sw}ρ$_{sw}$S＝heat transport by S with ΔT.
C_{sw}=4.184kJ/kgK=specific heat of sea water
ρ$_{sw}$(-2℃)=1028.2Kg/m^3=sea water density.
ΔT＝2～6(℃,K),

This is a fundamental scheme of heat transport=J by ocean current=S.

(6)**Themohaline Current=$S^{(-)}_{THC}$.**
$S^{(-)}_{THC}$(T)＝$S^{(-0)}_{THC}$－k(dT/dt).
$S^{(-0)}_{THC}$ is Thermohaline sea water current at now.If temperature down,THC must be increased,while temperature up,it must be decreased .Above is the most simple linear relation as an approximation.k=constant＞0. In temperature down process by the cooling,THC seems to act as negative feedback, That is,more cooling is to cause more THC outflow causing warmer Arctic.However it become evident in dynamic heat equation, that it become equivalent to increase Arctic Heat Capacity(re-normalizing to the larger heat capacity)by a certain degree.After all,stop cooling for accomplishing heat equilibrium state is to determined by temperature down in Cooling Radiation(the unique cooler in Arctic and Earth).

(7)**Ocean Current Volume Budget<0=inflow－Outflow>.**
Arctic Mediterranean exchanges: a consistent volume budget and trends in transports from two decades of observations
https://www.ocean-sci.net/15/379/2019/os-15-379-2019.pdf

[２]:Ocean Heat Current Budget<Heat Debt＝Heat inflows－Heat outflows>.

“Summary for Who are not good at Math”:

Off Nares current 0.8Sv is to cause also off (Barents＋Bering) current by 0.8Sv.
Now both act to heat input about by 7＋7＝14W/m^2,thereby both off is to reduce heat input=14W/m^2.That is,heat debt at now 4W/m^2 can be repayed with -10W/m^2 debt.
This shall cause temperature down toward heat equilibrium temperature by cooling radiation.This temperature could be estimated by following simple relation.
＊Annual average Cooling Radiation(CR)at now＝150W/m^2 by average T=257K,
＊CR at equilibrium temperature＝150-10=140W/m^2 by average T=?,
This is easily calculated by CR as a function of T .
The estimate value is about T=253,it is -4℃ down and may be enough for cooling.

Arctic Heat Capacity x T change/yr={heat inputs－CR heat output}yr.

＊In temperature down process,all heat inflow and outflow(0nly CR)can not be constant,but following are anticipated to be changed..
＊Themohaline current increasing by temperature down,the colder current output acts heat input. This negative feedback action is absorbed equivalently into ocean heat capacity increasing.That is temperature down process become rather slower.
＊Ice Albedo increasing by temperature down,solar heat input is reduced by ice lid increasing . This positive feedback action is absorbed equivalently into ocean heat capacity decreasing.That is temperature down process become rather rapidly.

By this heat capacity re-normalizing method,heat process equation becomes to depend only CR and shall conclude above result.This is very easy,but coarse method,however the tendency may be taken into account.

*The Influence toward Arctic Exterior Region=Full Earth !!.

Arctic rejects 14W/m^2 heat input,which turn back into earth to warm.However the effect become small by ratio between earth surface=5.1x10^{14}m^2 vs Arctic are=1.41x10^{12}m^2.
14x(1.41x10^{12}m^2.)/(5.1x10^{14}m^2)＝0.039W/m^2..This value would become small effective by 10years accumulation.Thereby Global Cooling Engineering must be executed both by Rapid Renewable Energy Building & Operation by Cloud Making Machine.Unless both simultaneous operation,we would fail.

“For Who are good at Math”:

After all,essence is account calculation for conserved variables(mass and heat).

Heat Debt/yr＝{Inflow$^{(+)}$heat＋outflow$^{(-)}$ heat＋THC$^{(-)}$heat＋solar heat－Cooling Radiation}/yr.

(1)$C(dT_0/dt)=J^{(+0)}+J^{(-0)}+J^{(-0)}_{THC}+J^{(0)}_{S}-J_{CR}(T_0)=+4W/m^2$ at now.

Note all the inflows and outflows are all heat input,but not Cooling Radiation output only!!!.

The Model Elements Table:

＊T＝Arctic Temperature ; →(dT/dt)＝Temperature rise/yr

＊C＝Total heat capacity of Arctic Ocean.→Heat Debt＝C(dT/dt)

Surface Current input$^{(+)}$ and output$^{(-)}$.depending on current intensity=S

(a)$J^{(+,-)}=\Delta T^{(+,-)}C_{sw}\rho_{sw}S^{(+,-)}$

(b)$0=J^{(-)}+\Delta s^{(-)}$＝Off outflow current at Nares strait＝0←0.80Sv.

(c)$0>\Delta J^{(+,-)}=\Delta T^{(+,-)}C_{sw}\rho_{sw}\Delta s^{(-)}$＝Heat flow change by$-\Delta s^{(-)}=-7W/m^2$.

☞: $\Delta J^{(-)}=\Delta T^{(+)}C_{sw}\rho_{sw}\Delta s^{(-)}$＝6℃?x4.184kJ/kgKx1000kg/m^{3}x0.80x10^{6}m^3/s

＝20x10^{12}TW＝14Wm^2?.

(bottom current)ThermoHaline Current depending on temperature trend=(dT/dt).

(d)$J^{(-)}_{THC}=J^{(-0)}_{THC}+\Delta J^{(-)}_{THC}$

(e)$S^{(-)}_{THC}(T)=S^{(-0)}_{THC}+\Delta s_{THC}=S^{(-0)}_{THC}-\beta$ (dT/dt).....<[1]:(6)>

(f)$\Delta J^{(-)}_{THC}=\Delta T^{(,-)}_{THC}C_{THC}\rho_{THCw}\Delta s_{THC}=-\Delta T^{(,-)}_{THC}C_{THC}\rho_{THC}\beta$ (dT/dt).

☞:T down act heat inflow to Arctic.This is negative feedback.

Solar Heat Input depending on temperature trend through ice lid area.

(g)$J_S=(1-a)I_S$＝(1-albedo)solar heat＝$(1-a_0)I_S+\gamma I_S$(dT/dt)＝$J^{(0)}_S+\gamma I_S$(dT/dt).

(h)$a=a_0-\gamma$ (dT/dt).....

☞:T up reduces albedo,T down increases albedo.This acts positive feedback.

Cooling Radiation the Unique Cooler of Arctic and Earth.

(i)$J_{CR}(T)=\alpha\ \varepsilon\ T^4$..

(j)(1)→ $C(dT/dt)=(J^{(+0)}+\Delta J^{(+0)})+(J^{(-0)}+\Delta J^{(-0)})$

$+<J^{(-0)}_{THC}-\Delta T^{(,-)}_{THC}C_{THC}\rho_{THC}\beta$ (dT/dt)>+<$I_S+\gamma I_S$(dT/dt)>$-J_{CR}(T)$.

(1)$[C+\Delta T^{(-)}_{THC}C_{THC}\rho_{THC}\beta-\gamma I_S](dT_0/dt)=(J^{(+0)}+J^{(-0)}+J^{(-0)}_{THC}+J^{(0)}_{S})+(\Delta J^{(+0)}+\Delta J^{(-0)})-J_{CR}(T)$.

☞:This is equation after off Nares current,which decrease heat by($\Delta J^{(+0)}+\Delta J^{(-0)}$)＜0.

After all,heat equilibrium(dT/dt=0)shall be accomplished by temperature down in $J_{CR}(T)$.

This equation reveals {THC negative feedback and albedo positive one}are vanished by re-normalizing the heat capacity C→[C＋δ $C_{T\&A}$]. It may be less heat capacity than C. Note this is not complete model,but the 1st order approximation the very coarse model. Thereby experts with computer are expected to calculate more exactly.

$[C+\delta C_{T\&A}](dT/dt)=J^{(+0)}+J^{(-0)}+J^{(-0)}_{THC}+J^{(+0)}_{S}-|\Delta J^{(+0)}+\Delta J^{(-0)}|-J_{CR}(T_0)$.

⑵Heat Equation after off Nares current.

Let's make Nares off effect as follows.

$[C+\delta C_{THC}](dT/dt)=J^{(+0)}+J^{(-0)}+J^{(-0)}_{THC}+J^{(+0)}_{S}-2\Delta J-J_{CR}(T)=4W/m^2-2\Delta J=-10W/m^2$.

Then heat equilibrium can not be accomplished by nothing,but by Cooling Radiation=$J_{CR}(T)$.

⑶How much Temperature would have been fallen ?!.

$J_{CR}(T_0=257K)=\alpha\ \varepsilon\ T_0^4=150W/m^2$....This is a coarse estimation with uncertain "α".

See Appendix-2,

＊ε＝5.67x10^{-8}.Stefan Boltzmann constant.

＊α＝[150W/m^2/ε x257^4]＝0.6064.....this is uncertain !!

T＝[140W/m^2/α ε]$^{1/4}$＝253K

→253-257＝-4(℃,K).....If this is exact,we could be saved by the ENGINEERING !!

⑷**Discussion.**

It is impossible to collect compatible data in ocean current budget and heat one by author. Thereby numerical conclusion may be uncertain !!.However he must express thanks to scientists who get an observed value by very long time hard work in extremely severe environments.

⒜Chronicle outflow deficit by Off 0.8Sv Nares current really reduce Bering and Barents inflow by 0.8Sv.?

Another surface outflows are ruled by P=(2/3)ρu^2 due to earth rotation and sea surface height. At first,sea surface height goes up, which may act toward u decreasing,because ocean weight become heavier to increase sea floor friction force.While sea surface height increase outflow.However it would be recovered after transient period.The outflow current flux must be the same before.Thus chronicle outflow deficit is to be accomplished. Possible way to stop sea surface rise is nothing,but volume sensitive inflow down in Barents sea and Bering strait.

⒝Doubling effect really accomplish heat input down＝-10W/m^2 ?

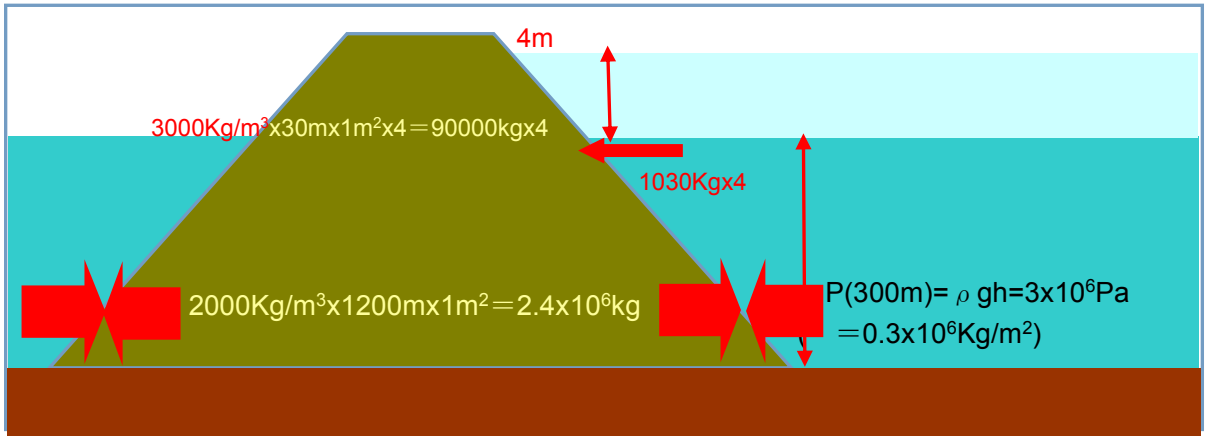
It is certain if both current would have been off.

PART Ⅱ:GATE BUILDING ENGINEERING to stop ocean current !

Building region is hard to work in cold and all day night winter.Our aim is turning input current toward not Nares inlet,which do'nt need complete blocking,but with through holes. Then possible construction method may be throwing massive stones to landfill the strait.

＊P＝ρ_{SW}gh＝1029 kg/m^{3}x9.8m/s^{2}x1m＝10100Pa.<10100Pa/(9.8m/s^2)＝1030Kg>

＊Stone density＝ρ_S＝3000Kg/m^3.



The Summary<See the details at APPENDIX-3,4,5,6>

It needs 20Km length Blocking Gate with top portion total pressure is about 40400Pa?.

The bottom(300m)pressure $P_W(300m)=\rho gh=1030kg/m^3x9.8m/s^2x300m=3x10^6Pa$.

①**Pressure at Top of the Blocking Wall**. $P_W=P_R+P_D+P_T=(7/6)\rho u^2+P_T$.

(a)Rotational flow pressure $P_R=(2/3)\rho u^2=(2/3)1030kg/m^3x(0.2m/s)^2=27Pa$.

(b)Equivalent wall behind Pressure P_D due to Deficit of Flow.

$P_D=(1/2)\rho\ \Delta u^2=(1/2)1030kg/m^3x(2m/s)^2=2060Pa$.

(c)**Tidal Current Pressure $P_T=\rho gh=1030kg/m^3x9.8m/s^2x4m=40400Pa$**<4120kg>

After all,the main pressure is "tidal current pressure" caused by sea level rise.

This needs very heavy building of something dam wall.

②**Blocking Efficiency**(1－<leak current/input one>)may be about 90%?.

This is important concept on blocking ocean current .Wall by landfill stones is leakable for ocean current(through hole wall by rate=k>.However it can realize substantial blocking out flow ocean current of colder heat. <See the details at APPENDIX-4(4)>

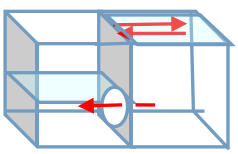
k=1:100%blocking without leak current and
with max wall pressure force $F=AP_0$.

k=0: 100% leak current and without nothing wall pressure.

0＜k＜1:blocking current with ratio=k,and with $F=kAP_0$.

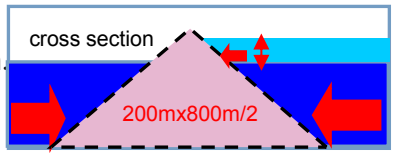
＊F＝force against wall.

＊A＝blocking wall area、、P_0＝Pressure at A with k=1.



③**Incomplete Blocking Wall as Landfill by Throwing Massive Stones**<>

Ocean current can pass through the wall by certain degree,which equalizes sea height.
Note horizontal pressure at both side of the wall is to cancel each others due to almost equal sea depth.
However top portion is not symmetric due to tidal alternate current<the height~2,4m?>.
This pressure may be tolerable by piling up heavy stones by certain size.



④**Mass of Landfill Stones**＝$\rho_s V$＝3000kg/m^3<20kmx[800mx200m]/2>＝5x10^{10}kg.

This is outrageous amount of Geo-Engineering.However it may be not impossible.

∗400ton dump trucks/3years＝5x10^{10}kg/(3yx183dx400.000kg)＝228trucks/day

Both side construction＝114trucks/day＝5trucks/hour(in all day works).

400ton dump truck is top heavy one in now world.Massive rocks is made by blasting.

Also many points marine operation may be possible,which could shorten building term.

This is decisive problem which must be asked the experts.

⑤**Is it Really Stable Wall against Possible Attacks ??!!**.

Higher safety factor design in the building is preferable,however it takes higher cost and time.Another strategy is preparation for urgent repairing for sudden damage of the wall.

This is decisive problem which must be asked the experts.

Serious Correction on the Gate Wall Pressure-1<2019/7/6>.

Note Nares straight is not river with up-down height difference,but is flat ocean.
Thereby such strong dam construction in ordinal river does not need.

(1)**Volume deficit by stopping strait current.**

If the strait current was stopped,gate wall pressure can not be $P=(3/2)\rho u^2$,but,must add $P=\rho gh$,where h=sea surface height difference between Arctic ocean side and Ares strait one. Because inner strait had vanished current,but become static sea volume of which surface must be lower than the Ocean side,because the surface volume by height=h must be flowed out to the strait outlet,Pressure decrease by the deficit volume must be add to the wall.

(2)h=sea surface height difference between Arctic ocean side and Ares strait one.
In order to make equivalent wall pressure P,let us assume hitting wall by current from higher slope position=h(then current velocity u=0). Then we employ energy conservation law.

"Bernoulli Theorem"for static non compressible flow<Energy Conservation Law>.

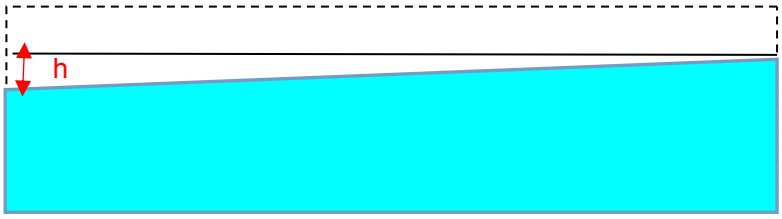
$(1/2)\rho u^2+P-\rho gh=U$<constant>.

Equivalent Pressure by Defcit of Flow

$(1/2)\Delta u^2=gh=(P).\rightarrow h=(1/2)u^2/g.$

$u=0.2m/s.$ <the strait current velocity average>.

$(1/2)x(0.2m/s)^2/(9.8m/s^2)=0.002m\rightarrow P=gh=20Pa.$



"**Another Solution" by Stationaly Fluid Equation**.

$\rho(<\mathbf{U}.\mathrm{grad}>\mathbf{U})=\mu\nabla^2\mathbf{U}-\mathrm{grad}P+\rho\mathbf{g}.$

$*(<\mathbf{U}.\mathrm{grad}>\mathbf{U})=\mathrm{grad}(U^2/2)+\mathrm{curl}x\mathrm{curl}\mathbf{U}=\mathrm{grad}(U^2/2)$.....<luminar current→curl**U**=0>

$\nabla^2\mathbf{U}=\mathrm{grad}(\mathrm{div}\mathbf{U})-\mathrm{curl}x\mathrm{curl}\mathbf{U}=0$.....<incompressible and luminar flow assumption >

$\rho.\mathrm{grad}(U^2/2)=-\mathrm{grad}P+\rho\mathbf{g}.\rightarrow\int_0^h dh<\rho.\mathrm{grad}(U^2/2)>=\int_0^h dh<-\mathrm{grad}P+\rho g>.$

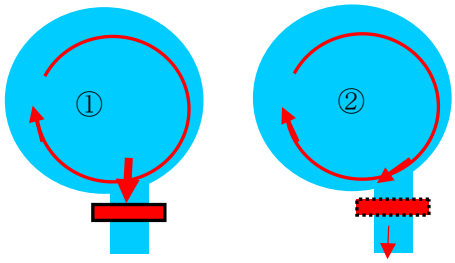
→

$0=\rho U^2/2+P-\rho gh=$constant<**Bernoulli Theorem**>

Serious Correction on the Gate Wall Pressure-2<2019/7/25>.

-Cyclic Tidal Current and the Pressure at the Wall.-

⑴View change from Stopping Nares Current to Turning Nares Current off from Nares.



①is a concept of complete stopping current.
②is a concept of not complete stopping,but allowing few leak current,which can reduce pressure at the wall drastically.After all,it is bending flow direction toward non Nares direction.This method overcome difficulty of wall pressure,however with losing blocking efficiency.

⑵**Tidal Current at Nares Strait.**

The Arctic Ocean Tides

http://fvcom.smast.umassd.edu/2014/01/27/4-research-tidal-simulation/

By the animation,we could see tidal current at Nares strait,then tidal amplitude could be seen very about 10km at Nares inlet.

The Impact of Tides on Simulated Landfast Ice in a Pan-Arctic Ice-Ocean Model

https://archimer.ifremer.fr/doc/00460/57132/59053.pdf

⑶**How Much Tidal Force?.**

It is measured by sea level rise,for example,2m height is

$P = \rho gh = 1030kg/m^3 x 9.8m/s^2 x 2m = 20200Pa$<2060kg>

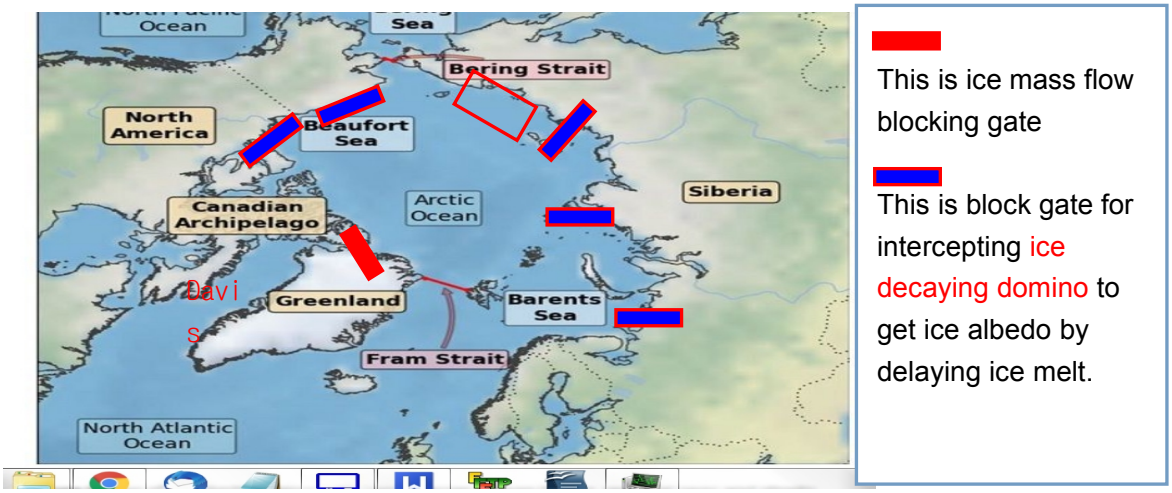
Maybe rocks landfill wall could be tolerable such force.

See the details at APPENDIX-3,4,5,6.

APPENDIX-1:The Topography and Ocean Current in Arctic.

This is least-knowledge by authors selection for following explanations.

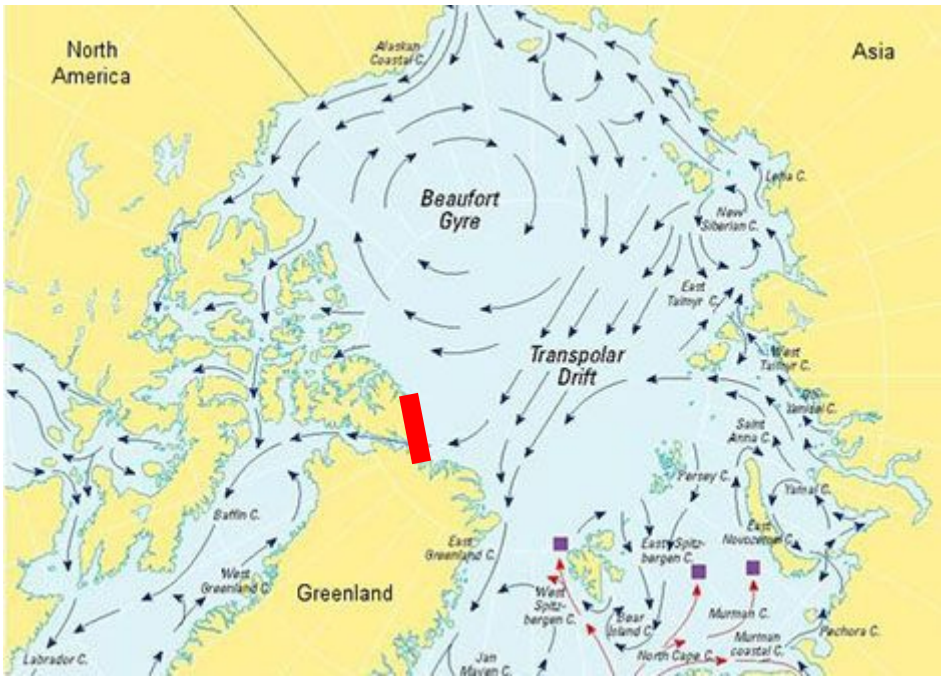
⑴The Possible Targets Region in the Map



https://www.metoffice.gov.uk/research/climate/cryosphere-oceans/sea-ice/overview

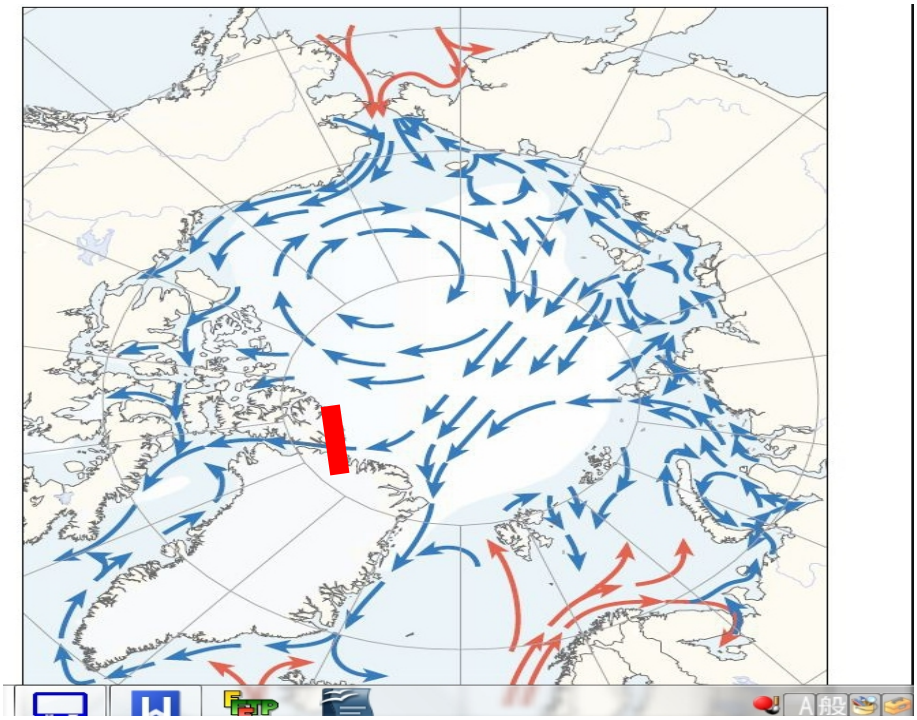
⑵***Arctic Ocean Surface Currents Map***.

https://www.treehugger.com/natural-sciences/global-warming-may-lead-to-more-polluted-arctic-waters.html



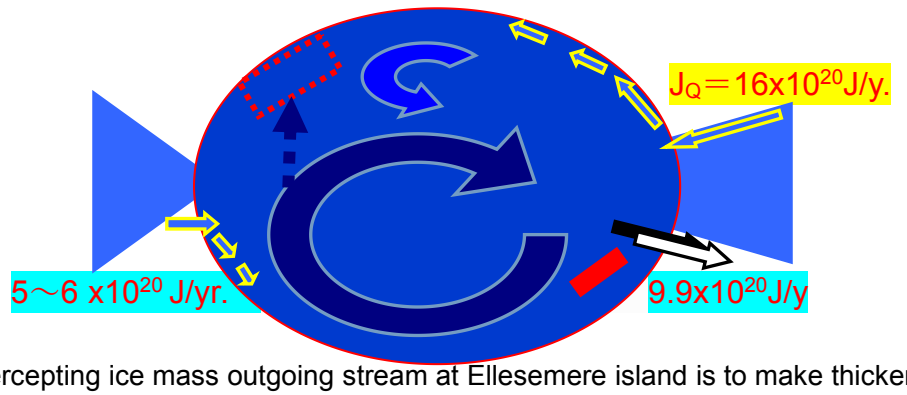
http://library.arcticportal.org/1375/1/CAFF_Map_No_43_Surface_ocean_currents_and_the_minimum_extent_of_sea_ice_in_the_Arctic_2001.JPG

The gate is to block outgoing ice mass stream.This is to cause thicker ice to cool global arctic ocean.



(3)Bering & Barents Hot Sea Currents and ESAS the Emergency.

This is fluid dynamics problem for ESAS.Coriolis force by earth rotation is to cause hot input flow from Bering & Barents sea go along sea shore.This is main cause of earlier ice decay (June) at both shore(yellow arrow regions).Thereby,ice thickening at both region would be effective to make delay time in ice melt.



Intercepting ice mass outgoing stream at Ellesemere island is to make thicker rotating ice (Beaufort Gyre),which might flow into ESAS.

Arctic ice cap volume and thickness - daily measurements between Jan 2003 and June 2018.

https://www.youtube.com/watch?v=0loIDvze_nI

This is the most precise animation !!!.

Nares Strait
https://www.youtube.com/watch?v=4Huhs1e2XKM

Lord Ivan Canas: Global Warming: Nares Strait Melting during winter months!!
https://www.youtube.com/watch?v=Qbhuvszn4nI
Lord Iván Emiro Cañas Gutiérrez:2008/09/05
2007/2008 winter, sudden large flows in Nares Strait between Baffin Bay and the Arctic Ocean are shown in this time lapse from satellite images from Oct 2007 to April 30, 2008. This flow did not occur in past years and generally the area north of Ellesmere Island and North Greenland is pretty solid with old ice.

Huge ice island breaks from Greenland glacier
https://www.youtube.com/watch?v=BTuDaQarKKI
Nares Strait
https://en.wikipedia.org/wiki/Nares_Strait

A2:Overview on Arctic Heat Budget now Causing Fatal Ice Volume Decline.

❶ARCTIC HEAT BUDGET the fundamental.

(a)**heat debt in air(atmosphere).**

＝boundary inflow＋net solar input＋net radiation output＋ocean contact outflow

$\partial A/\partial t = -\mathrm{div}\mathbf{J}_A + \langle I_S(1-a_{TP}) - I_S(1-a_{TP})(1-a_0)\rangle - \langle R_{TP} - R_0\rangle - B_O$.

(b)**heat debt in sea**＝boundary inflow＋net solar input＋radiation output＋air contact inflow

$L_i + S_i + S_O = \partial O/\partial t = -\mathrm{div}\mathbf{J}_S + I_S(1-a_{TP})(1-a_0) - R_0 + B_O$.

Vanishing Terms in Annual Average.

(c) $0 = \langle \partial A/\partial t \rangle$.

(d) $0 = \langle B_O \rangle$.

https://pdfs.semanticscholar.org/b138/085ec68172707f1e28a5ebadab0f9bfd9f80.pdf

Table 2. Monthly and Annual Mean Energy Budget Terms for the Arctic Ocean Domain

	Fluxes and Storage Changes									
Month	$\partial A_E/\partial t$	R_{top}	$-\nabla \bullet \mathbf{F}_A$	F_{sfc}	$\partial O_E/\partial t$	S_o	L_i[a]	$\nabla \bullet \mathbf{F}_i$	$-\nabla \bullet \mathbf{F}_o$	Res.[b]
January	−4	−178	81	58	−52	−19	−33	3	3	−35
February	4	−175	91	53	−47	−16	−31	3	3	−35
March	12	−150	93	41	−34	−9	−25	4	3	−28
April	25	−96	72	20	−14	6	−20	4	2	−29
May	20	−37	44	−14	18	27	−9	3	2	−27
June	19	16	79	−75	79	40	40	3	2	1
July	2	10	91	−100	105	35	69	2	3	−1
August	−17	−68	92	−45	50	11	39	1	3	−4
September	−28	−150	95	18	−13	−5	−8	2	3	−9
October	−22	−186	97	58	−52	−4	−48	3	3	−9
November	−11	−186	85	59	−53	−29	−25	3	3	−31
December	2	−180	90	59	−52	−37	−15	4	3	−33
Mean	0	−115	84	11	−5	0	−5	3	3	−20

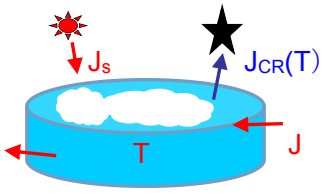
[a] L_i is calculated as the difference between the measured terms $\partial O_E/\partial t$ and S_o.
[b] The residual is calculated as $R_{top} - \nabla \bullet \boldsymbol{F}_A + F_{sfc} = \partial O_E/\partial t$.

(e)**Ocean Heat Budge the Essential in Arctic**.

$L_i + S_i + S_O = \partial O/\partial t = -\mathrm{div}\mathbf{J}_S + I_S(1-a_{TP})(1-a_0) - R_0$.

ocean heat debt=ice latent heat＋ice sensible heat＋ocean sea water sensible heat

＝boundary inflow(in arctic gates)＋net solar ocean input＋ocean surface radiation output



＊sea ice specific heat C_i＝2.1kJ/kgK.....

＊sea water specific heat C_{sw}＝4.184kJ/kgK

＊sea ice latent heat L_i＝3347kJ/kgK

(d)**Annual Heat Budget Equation in this report**<see above fig>.

＊C(T)

=Arctic ocean heat capacity by ice(latent＋sensible)heat＋ocean water sensible heat

$\partial O/\partial t = C(T)dT/dt = J + J_s - J_{CR}(T)$

Heat Debt＝(ocean heat input)+(solar heat input)－(cooling radiation output).

＊latent heat＝melting,or freezing heat of ice(no temperature change in transition)

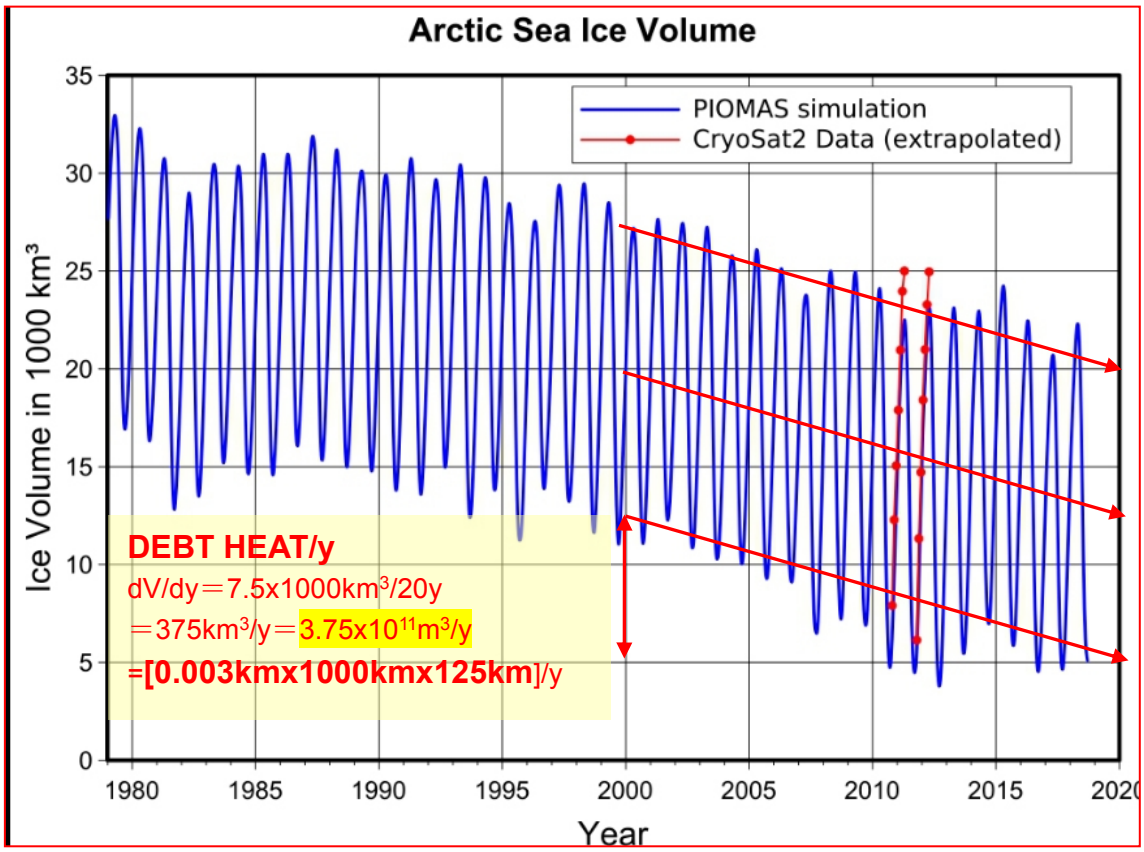
＊sensible heat＝heat for temperature change

❷ARCTIC HEAT BUDGET the coarse estimation.

Ice volume decline rate=dV/dt is heat debt increasing the most kernel variable.Arctic ocean sea water warming may be less than that of ice.Both are the real debt＝4W/m^2.

⑴***SEA ICE Volume Change***<＊Arctic Area=S＝1.41x$10^{12}$$m^2$>

https://en.wikipedia.org/wiki/Arctic_ice_pack#/media/File:Plot_arctic_sea_ice_volume.svg



⑵1m^3 Ice melting heat

C_{im}＝334kJ/kg;; ρ_{im}＝0.9168 g/cm^3＝0.9168x10^3K g/m^3.→ $C_{im}\rho_{im}$＝3x10^8J/m^3.

⑶Arctic Ice Volume Decline Rate/year

(dV_{ice}/dy)＝375km^3＝3.75x$10^{11}$$m^3$/y.

⑷Arctic Ice Volume Shrink(375km^3)Heat Debt Rise Rate/year

dQ/dt＝ $\rho_i C_{im}$(dV_{ice}/dy)=3x10^8J/m^3x3.75x$10^{11}$$m^3$/y.＝1.2x$10^{20}$J/y＝3.8TW＝2.7W/$m^2$.

⑸Solar Heat Input Wild Estimation for Clouds Albedo Engineering.

W_s＝300W/m^2x3600sx24hx30dx3m＝2.3x10^9J/m^2

〈dQ/dt〉/W_s＝1.2x10^{20}J/2.3x10^9J/m^2＝5.1x$10^{10}$$m^2$＝(500kmx102Km).

This area should be covered by Clouds made by the machine.

⑹**Arctic Heat Budge the Coarse Overview.**

dQ/dt＝J_i－J_0＝Annual Heat Debt increase＝(Heat Input－Heat Output)/y

Heat Debt SUM＝4W/m^2.	
Ice Decay This value may be certain and very fundamental.	dQ$_I$/dt＝ $\rho_i C_{im} dV_{ice}/dy$ ＝ $\rho_i C_{im}$[0.003kmx1000kmx125km]/y＝1.2x10^{20}J/375km^3. https://en.wikipedia.org/wiki/Arctic_ice_pack#/media/File:Plot_arctic_sea_ice_volume.svg J(TW)=1.2x10^{20}J/3600x24x365＝3.8TW. J(TW/S_A)=1.2x10^{20}J/(3600x24x365x1.41x10^{12}m^2)＝2.7W/m^2.
Ocean Surface Warming In beginning of Arctic warming,this value may be higher at now.	ocean warming is due to both ocean heat input and ice lid years decline(albedo decreasing).Fundamentally temperature of sea water=T_{SW} with ice float should be about 273K,however in Arctic ocean seems complicated . T_{SW}=-1～-2℃(200m depth) C_{AO}(dT/dt)＝[4.184KJ/Kgx1000Kg/m^{3}x1m^{2}x200m](1K/20y)＝4.1x10^{7}J/ym^2＝1.3W/m^2 https://www.eea.europa.eu/data-and-maps/figures/sea-surface-temperature-anomaly-for-period-1870-2006
SUM of Heat input into Ocean with Ice＝(108＋22?)＋20=150W/m^2?.	
Ocean Heat Input	https://www.ocean-sci-discuss.net/os-2017-98/ The net ocean heat transport to the Arctic Ocean is similar in the two datasets (observation-based: J_Q＝48x10^{20}J/y J(TW)=153 ± 44 TW=48x10^{20}J/y, reanalysis: 145 ± 35 TW). J(TW/S_A)=108W//m^2→
Atmos Flow Input This value seems poorly credible.	84W/m^2???.→21W/m^2? https://pdfs.semanticscholar.org/b138/085ec68172707f1e28a5ebadab0f9bfd9f80.pdf See APPENDIX-1
Solar Heat Input into ocean with ice	20W/m^2← https://www.researchgate.net/figure/Arctic-wide-total-solar-heat-flux-under-sea-ice-Q-T-black-and-monthly-Arctic-wide_fig4_268818424 I_A＝173W/m^2 →I_A(1-0.3?(clouds))(1-0.83?(ice lid))＝20W/m^2 https://skepticalscience.com/earth-albedo-effect.htm
SUM of Heat Output from Ocean with Ice＝135W/m^2?→150W/m^2?(257K) https://atmos.washington.edu/~qfu/Publications/grl.yang.2014.pdf	
Radiation Output	R_C＝115W/m$_2$??.＝ασT^4. https://pdfs.semanticscholar.org/b138/085ec68172707f1e28a5ebadab0f9bfd9f80.pdf

The last adjustable variable is nothing ,but this.If we take atmos=84,R_C=212 which means T＞273.Ridicule !	＊σT(240~273)^4＝5.67x10^{-8}T^4＝188～314W/m^2 ＊Emissivity atmosphere ：α＝0.61? → R_C＝120～192W/m^2 In Arctic with less vapor,maybe α＞0.61.→ stronger radiation !! ＊About equation for Radiation Balance on Earth ： (1366Wm^{-2}/4)(1-0.3)＝ασ(273+15)^4 → α＝0.61. *＊Arctic Temperatuer at Region* https://www.met.nps.edu/~psguest/polarmet/climate/arcmap.html

＊R_C could be observable by satellite scope,however nothing data !!

⑺**The Main Gate Ocean Heat Input**.

⑷***Heat in the Barents Sea: transport, storage, and surface fluxes***
https://www.ocean-sci.net/6/219/2010/os-6-219-2010.pdf
1997–2007 mean heat transport by the Atlantic Water in the Barents Sea Opening is 49.7 TW=＋35W/m^2 (Skagseth et al., 2008). This heat transport compares to cooling the inflowing 2.0 Sv from 6.1 ◦C to 0 ◦C.

→J_Q＝Sv $\rho_{sw}C_{sw}\Delta T$＝4.184x10^{12}J/sxSv ΔT＝4.184x10^{12}J/sx2.0x6,1＝5.1x10^{13}J/s
J_Q＝16x10^{20}J/y＝50TW.....3times larger than Bering strait !!!!!

Sea water specific heat,the density
C_{sw}＝4.184kJ/kgK;; ρ_{sw}＝1000kg/m^3....Sv＝10^6 m^3/s

⑸***Fram Strait sea ice export variability***
https://www.the-cryosphere.net/11/65/2017/tc-2016-79.pdf
Ice flow output(Fram strait)～600,000 and 1 million km²＝240km^3.
Fram Strait sea ice export affected by thinning.
https://link.springer.com/article/10.1007/s00382-019-04699-z
The simulated mean annual(1990–2010) volume export is 3.3 x10^3 km^3/y＝9.9x10^{20}J/y
J_Q＝9.9x10^{20}J/y＝31TW＝22W/m^2.

⑹***Volume, Freshwater, and Heat Fluxes through Davis Strait, 2004–05****
https://journals.ametsoc.org/doi/full/10.1175/2010JPO4536.1
Davis Strait volume [−2.3 ± 0.7 Sv (1 Sv ≡ 10^6 m^3 s^{-1}); negative sign indicates southward transport], freshwater (−116 ± 41 mSv), and heat (20 ± 9 TW) fluxes estimated from objectively mapped 2004–05
J_Q＝6.x10^{20}J/y=20TW=14W/m^2.

⑺***The 2007 Bering Strait(~1Sv) oceanic heat flux***
https://pdfs.semanticscholar.org/1fba/bca827f4ee7aa421605a74909d390a478abc.pdf
Heat fluxes increase from 2001 to a 2007 maximum, 5～6 x10^{20} J/yr.
The 2011 Bering Strait heat flux is enough to melt ~1.5x10^{6}km^2 of 1m thick ice＝4.5x10^{20}J.
J_Q＝5.5 x10^{20} J/yr=17TW=12.4W/m^2.

(e)***Volume and Freshwater Flux Observations from Nares Strait to the West of Greenland at Daily Time Scales from 2003 to 2009***

https://pdfs.semanticscholar.org/787a/911550540845fa02edce662b5e93340e3438.pdf

＊multiyear mean fluxes that range from 0.71±0.09 to1.03±0.11 Sv

＊Advection of ice adds another 8±2 mSv or 260±70km^3 yr^{-1}=0.008Sv

＊C_{SW}=4.184kJ/kgK

＊$C_{im}\ \rho_{im}$=3x10^{8}J/m^3

Ice:$VC_{im}\ \rho_{im}$=3x10^{8}J/m^{3}x260±70km^3 yr^{-1}=0.78x10^{20}J/yr=2.5TW=1.75W/m^2..

0.85S_V→0.85x10^{6}m^3/sx1000kg/m^{3}x4.184kJ/kgKx6.1℃=21.7x10^{12}TW=15.4Wm^2.

0.85S_V→0.85x10^{6}m^3/sx1000kg/m^{3}x4.184kJ/kgKx.3℃？=10.8x10^{12}TW=7.74Wm^2.

Nares Strait Heat Flow in this Report.

Davis strait flow 14Wm^{-2} is sum of “Pally channel and Nares”,so 7Wm^{-2} may be modest.

(8)***Volume and temperature transports through the main Arctic Gateways: A comparative study between an ocean reanalysis and mooring-derived data***

https://www.ocean-sci-discuss.net/os-2017-98/

The net ocean heat transport to the Arctic Ocean is similar in the two datasets (observation-based: 153 ± 44 TW=48x10^{20}J/y=108W/m^2, *reanalysis:* 145 ± 35 TW).

Ocean Heat Flux.

https://neven1.typepad.com/blog/2012/06/ocean-heat-flux.html

(9)**SUMMARY of [1]:**

☞:As you have known,the heat budget at here is most important,however the certainty is rather weak due to failure in collecting the data.Author strongly claim that the data should be disclosed to global public,because this is the deadly problem of do or die for all of us.So also you should try to build own heat budget.

Total heat input must be completely cancelled with (output Radiation＋the HEAT DEBT =4W/m^2).This value must be vanished by decreasing something in heat input. Stopping air and ocean current may be harder to accomplish.Then possible left answer are intercepting solar heat input and intercepting outgoing ice mass streams in straits .

Thereby ,in this paper discuss the later by ice making method.Then (7)(c)(d) may be better.

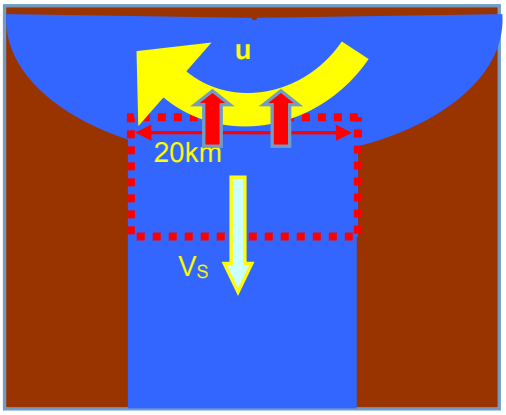
Arctic ice cap volume and thickness - daily measurements between Jan 2003 and June 2018.

https://www.youtube.com/watch?v=0loIDvze_nI

This is the best animation !

A3:Forces at Gate Block by Rotational Ocean Current(the Simple Model)

(a)Forces at Gate Block(the Simple Model).....This is very important in this report !!.



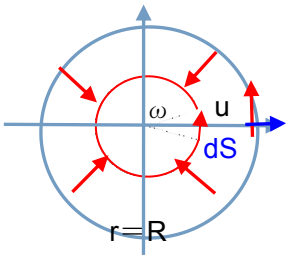
Strait sea water flow＝V_S～10,20cm/s
①Surface friction force $F_F=\eta S_B V_S$.
S_B=Bottom area of ice block.
friction coefficient= η

Pressure by curving sea Ice&water flow=F_P.
②$F_P=\iiint dW<(\mathbf{u}.\mathrm{grad}).\mathbf{u}>$
This is main force hitting side surface of the block due to curving of the strong current.

②$F_P/\rho=\iiint dW<(\mathbf{u}.\mathrm{grad}).\mathbf{u}>=\iiint dW(\frac{1}{2}\mathrm{grad}.\mathbf{u}^2-<\mathbf{u}\times\mathrm{curl}\mathbf{u}>)=\frac{1}{2}\oiint d\mathbf{S}<u^2>-\iiint dW<\mathbf{u}\times\mathrm{curl}\mathbf{u}>$
$=-<\mathbf{u}>\times\iiint dW.\mathrm{curl}\mathbf{u}=-<\mathbf{u}>\times\oiint<d\mathbf{S}\times\mathbf{u}>=P\oiint d\mathbf{S}.$
$F_P=-\rho\iiint dW<\mathbf{u}\times\mathrm{curl}\mathbf{u}>=-\rho<\mathbf{u}>\times\oiint<d\mathbf{S}\times\mathbf{u}>=P\oiint d\mathbf{S}.$

＊**circular current assumption**：$\mathbf{u}=(-u.\sin\theta,u.\cos\theta,0)=(-uy/\sqrt{(x^2+y^2)},ux/\sqrt{(x^2+y^2)},0)$
＊$\mathrm{curl}.\mathbf{u}=(\partial_y u_z-\partial_z u_y,\partial_z u_x-\partial_x u_z,\partial_x u_y-\partial_y u_x)=(0,0,\partial_x u_y-\partial_y u_x)$
＊$\partial_x u_y-\partial_y u_x=u/\sqrt{(x^2+y^2)}+uxy/\sqrt{(x^2+y^2)}+u/\sqrt{(x^2+y^2)}-uxy/\sqrt{(x^2+y^2)}=2u/r.$

$$<\mathbf{u}\times\mathrm{curl}\mathbf{u}>=\begin{vmatrix} e1 & e2 & e3 \\ -u.\sin\theta, & u.\cos\theta, & 0 \\ 0, & 0, & 2(u/r) \end{vmatrix}=[(2u^2/r)\cos\theta,(2u^2/r)\sin\theta,0].$$



.....This is centrifugal force by curvature radius=r.

③Circular Current Model and Pressure at the Circle Wall.

＊u(r)≡rω.[0≦r≦R];complete circular current model with angular velocity=ω.
＊h:wall height at circle edge at r=R.
$P\oiint d\mathbf{S}=\rho\iiint dW<\mathbf{u}\times\mathrm{curl}\mathbf{u}>=\rho\iiint dW(2u^2/r.)=2\pi h\rho\int drr(2u^2/r)=2\pi h\rho\omega^2\int dr.r(2r^2/r.)$
$=4\pi h\rho\omega^2\int dr.r^2=(4/3)\pi h\rho\omega^2R^3.$
$\oiint d\mathbf{S}=h2\pi R.\quad\rightarrow\quad P=(4/3)\pi h\rho\omega^2R^3/h2\pi R=(2/3)\rho\omega^2R^2=(2/3)\rho u^2.$

(b)**Pressure at the Blocking Wall.**

$P=(2/3)\rho u^2.$

＊$P=(2/3)\times1000kg/m^3\times(0.1m/s)^2=6.7Pa$
＊$S_BP=20km\times3m\times(2/3)\times1000kg/m^3\times(0.1m/s)^2=6\times10^5N=60ton.$ weight measure

(c)**Surface friction force** $F_F=\eta S_B(\partial V_S./\partial h)$
＊friction coefficient= η =0.000890Pa.s
$F_F=\eta(\partial V_S./\partial h)=0.000890((0/1m/s)./0.01)=0.0089N/m^2.$
$S_BF_F=20km\times1km\times0.0089N/m^2=1.78\times10^5N=18ton$ weight measure

A4:Tidal Pressure Forces at Blocking Wall(the Coarse Estimation).

There's doubtful & unclear discussions at here & there.But conclusion is 4m seal level rise !!

(1)Tidal Current at Nares Strait.

The Arctic Ocean Tides

http://fvcom.smast.umassd.edu/2014/01/27/4-research-tidal-simulation/

By the animation,we could see tidal current at Nares strait,then tidal amplitude could be seen very about 10km at Nares inlet.

The Impact of Tides on Simulated Landfast Ice in a Pan-Arctic Ice-Ocean Model.

https://archimer.ifremer.fr/doc/00460/57132/59053.pdf

(2)Pressure and Seal Level Rise at Wall.

"Bernoulli Theorem" is correspond to following simple stationary scalar flow.

Thereby,the exact application is restricted within above condition.

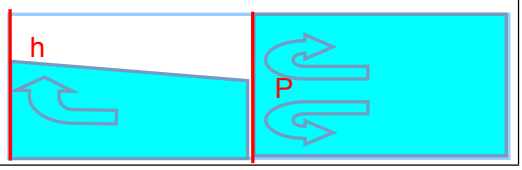
$\rho(<\mathbf{U}.\mathrm{grad}>\mathbf{U})=\rho.\mathrm{grad}(U^2/2)=-\mathrm{grad}.P+\rho g.$

This is energy conservation law in fluid,which is expressed{P,h}as function of U.

$\rho U^2/2+P-\rho gh=$constant<**Bernoulli Theorem**>.

→ $h=U^2/2g.$;; liquid level rise by stopping U=0

→ $P=\rho U^2/2.$;;; wall pressure rise by colliding U



If U=2m/s → $h=(U^2/2g)\fallingdotseq 0.2m?$. If U=4m/s → $h=(U^2/2g)\fallingdotseq 0.8m?$.

$\rho=1029\ kg/m^3$.If U=2m/s → $P=\rho U^2/2=\rho 2^2/2=2058Pa$.

(3)Full Set NS Equation<this is unsolvable in analytical way>.

(a) $\partial \mathbf{U}/\partial t+\rho(<\mathbf{U}.\mathrm{grad}>\mathbf{U})=\mu\nabla^2\mathbf{U}-\mathrm{grad}P+\rho<\mathbf{U}x\omega>+\rho\mathbf{g}+\rho\delta\mathbf{g}(t)$. . . . . (3)(a)

(3)(a) is full set NS equation,where $\delta\mathbf{g}(t)$ is time dependent tidal gravity force.Let's coarsely estimate intensity $\delta\mathbf{g}$ by assuming velocity $\mathbf{U}(t)=U_0\sin(2\pi t/T)=$(2m/s).sin(2π t/12x3600).

In order to solve,lets take wild assumption of neglecting, $\rho(<\mathbf{U}.\mathrm{grad}>\mathbf{U})=\mu\nabla^2\mathbf{U}-\mathrm{grad}P+\rho<\mathbf{U}x\omega>+\rho\mathbf{g}$,which is to yield simple vibration dynamics=(b).

(b)Tidal Pressure Force= $\rho\delta\mathbf{g}$ and the max Horizontal Pressure at Wall=P_H.

$\rho\partial\mathbf{U}(t)/\partial t\fallingdotseq\rho\delta\mathbf{g}(t)$. → $\delta\mathbf{g}(t)=$(2m/s)((2π/12x3600).cos(2π t/12x3600).

=(2m/s)((2π/12x3600).cos(2π t/12x3600)=0.0004m/s² ≪ 9.8m/s²=g.

This is correspond with "ρgh" of "density x gravity force" pressure at bottom floor.

∗$P_H=\rho\delta gA$. <A=tidal amplitude(c)>

∗Sea level height=the stationary term+tidal one=$\rho g(h_0+\delta h)=\rho gh_0+P_H$.

$P_H=\rho\delta gA=\rho g\delta h.$→ $\delta h/A=\delta g/g\sim(0.0004m/s^2)/(9.8m/s^2)$.

After all,tidal pressure should be measured by sea level rise= δh,which may be certain.

$\delta h=(U^2/2g)$.....This is Bernoulli Theorem between δh and max tidal current velocity=U.

(c)**Tidal Amplitude and the Sea Water Volume through Gate in The Cycle(12H).**

U(t)＝U_0sin(2 π t/T)＝(2m/s).sin(2 π t/12x3600).

x(t)＝ ∫ dt**U**(t)＝(T/2 π)U_0sin(2 π t/T)＝13800m.sin(2 π t/12x3600).

This may be tidal amplitude,

(d)**Tidal Horizontal Pressure at Wall??<**∗P_H is rather uncertain for author**>.**

{P_K; δ h} are calculation by *Bernoulli Theorem*,which are weaker than the vibration dynamics

Especially note U is tidal component only,the actual is U+v(strait DC current)～4m/s(max).

max velocity=U	U=1m/s	U=2m/s	U=3m/s	U=4m/s
Tidal Amplitude=A	6.9km	13.8Km	20.7km	27.6km
P_H＝ρ δ **g**(t)A	1408Pa	5630Pa	12668Pa	22520Pa
P_K＝ρU^2/2	515Pa	2058Pa	4630Pa	8232Pa
δ h＝(U^2/2g).?	0.005m	0.2m	0.46m	0.82m

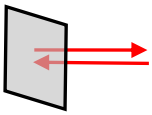
☞:P_H is stong pressure at wall,however this could be relaxed by through hole wall=(4) for sea water.That is not complete pressure blocking wall,but incomplete one due to equalize sea surface height.

(4)**Wall Pressure Reduction By Leaking Fluid at Wall**(kA=cross section).

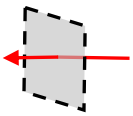
This is simple idea on Through Hole Wall(Rock Landfill).A=max wall cross section.

(1-k)is through hole ratio in A.Flow volume/s behind wall＝S, F＝full force at wall.

(a)Full Stopping Current of Velocity=U →P＝ρU_1^2/2 → F＝AP;;S＝0 (flow volume/s)



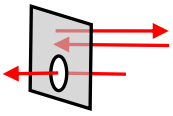
(b)Full Passing Current of Velocity=U →P＝0 → F＝0: ; S＝AU(flow volume/s)



(c)Partial Passing Current of Velocity=U [Blocking Efficiency=k;;0＜k＜1]

→P＝0(through hole), P＝ρU_1^2/2(partial wall＝kA).

→ F＝kAP; S＝A(1-k)U.



(d)**Through Hole Wall(Rock Landfill)**.

In order to simplifying wall construction,let's assume throwing stones method.

This can not be complete blocking gate,but with leaking current with(1-k).

If k～0.9,it is almost complete for blocking efficiency.

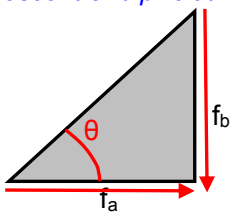
So far amateur author's survey,wall building by decent steal and concrete is higher cost. Above all,construction region is extremely cold and complete dark in winter for hard work. If wall is constructed with throwing stones to sea flor,the wall can not completely seal sea current.However it could be sufficient to turn direction of cold strait sea current from non strait inlet.Sea level rise 4m/s at top of wall could not move the piled up stones.

A5:Landfilling<Estimation on Amount of Rocks for the Landfill>

(1)This is primitive method by throwing massive stones into strait floor.The number is outrageous, but may be not impossible.The exact engineering needs the experts view.

(a)***Angle of Repose*** ; ; ; Earth, granite＝35～40°,but not in underwater,in water ?.
https://en.wikipedia.org/wiki/Angle_of_repose

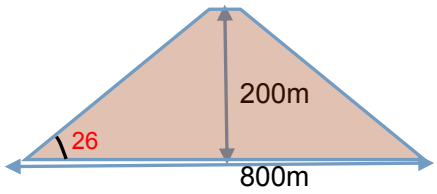
The angle of repose, or critical angle of repose,[1] of a granular material is the steepest angle of descent or dip relative to the horizontal plane to which a material can be piled without slumping.



This is authors opinion,but not authorized explanation.
Tanθ＝[(1/f_b)/(1/f_a)]＝[f_a/f_b)]
f_a＝horizontal max tolerable force for slope slump.
f_b＝vertical force by material mass;

(b)Rock mass in underwater reduce 3000Kg/m^3－1029kg/m^3＝2000Kg/m^3.
This may act decreasing 37°→θ＝Tan^{-1}[(Horizontal force/Vertical one)x2/3?]
(Vertical force/Horizontal one)＝Tan(37°)＝0.75→θ＝Tan^{-1}[0.75x2/3]＝26°??

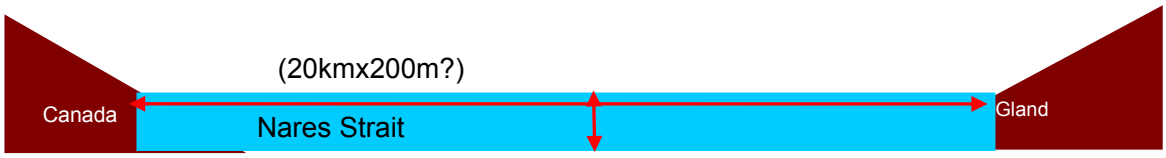
(c)Assuming average depth=200m,and bottom width=800m.



Slope Angle=26° .
S＝800m^2. V＝20,000mx800m^2＝1.6x$10^7$$m^3$.
＊rock density＝3000Kg/m^3
＊Total Mass of Rocks M＝ρV＝5x10^{10}kg.

(b)Land Operation.

How much Dump Trucks(400ton)<these story must be asked the experts>.
M/400000Kg＝5x10^{10}kg/400000Kg＝1.25x10^5.→ 1.25x10^5/3yx365d＝114 dump cars/day
114dump cars/16h＝7.1dump cars/h.→ double side construction. → 3.6 dump cars/h.
(114x400ton=4,5600ton/day)



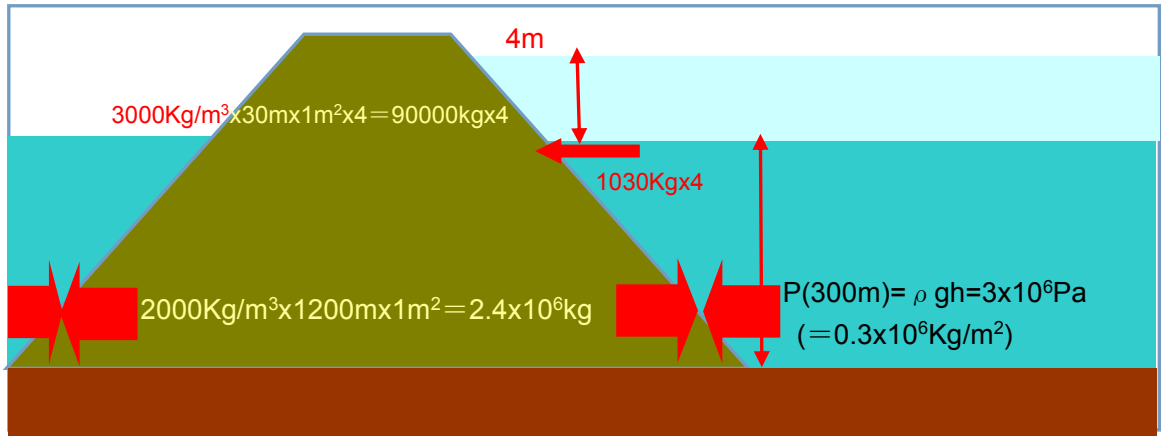
(c)**Marine Operation**<these story must be asked the experts>..
10000tonx10ships/day.＝10,0000ton/day.
*Is there working ship of throwing stones 10000ton ?.
*Shipping works need mass dump cars at each harbor.

(d)Construction Adjusting Engineering.

How to build strongly stable wall gate by throwing stones ??
Especially how to build stable steep slope??.
However there is underwater construction machine with remote control !.
It may be depends on the machine ability,of which development must be urgent.
Underwater Backhoe Big Club
https://www.aomi.co.jp/tech/civil/biggrab.html
Even in weak visible environment,remote controlled work would be possible.
Ancient Egyptian had done the great works,while modern men could do what ?
Dimensions of the Cheops-pyramid (Khufu's pyramid)
https://www.cheops-pyramide.ch/khufu-pyramid/khufu-numbers.html
The height=146m,The slope surface angle is told 58.3°＞45°.

(2)Rocks Landfill Wall against the Sea Depth Pressure.

This is the kernel discussion whether rock wall act well or not ?!!
＊P＝ρ_{sw}gh＝1029 kg/m^{3}x9.8m/s^{2}x1m＝10100Pa.<10100Pa/(9.8m/s^2)＝1030Kg>
＊Stone density＝ρ_S＝3000Kg/m^3.



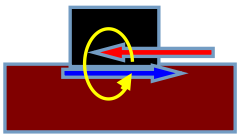
Let's consider bottom rock unit box(1200mx1m^2).
Then rock mass of 2.4x10^{6}kg can resist against sea water pressure=0.3x10^{6}Kg/m^2 ?
Note not only right side,also left side get resisting force by sea water pressure !!.

Let's consider top rock unit box(30mx1m^2).
Rock mass of 90000kgx4 can resist against sea water pressure=1030Kg/m^{2}x4 ?
The critical ratio value of **vertical force/horizontal one～8??** is discussed in A6.

A6：Horizontal Resistive(=friction)Force= F_H vs Vertical Pressure=F_V in Wall Pressure

Author tried to find the comprehensible solution in web,but failed.Here is his last resort. There by readers must ask the experts for the exactness.

⑴Rotational force generating due to horizontal pressure and frictional resistive one.
Frictional force is due to depth of irregularities and fragility on the matter surface.
Note **static dynamics** is calculation on {vector sum=0 and torque=0}.



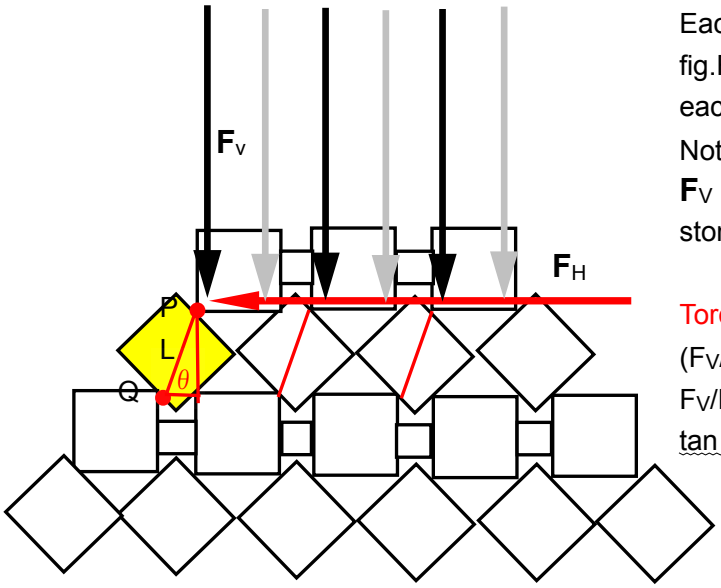
$\mathbf{F}_H - \mathbf{F}_F = 0$ Stable static relation as vector sum.
curl$\mathbf{F} = \mathbf{f}_R$.Rotational force toward breaking static condition.
The rotation is due to something torque force.

⑵**The torque force estimation by very coarse model.**

Following is very wild explanation of static friction force in piled up stones.

***$\mathbf{F}_V$**=nmg=n stone mass gravity force by volume of width x unit are for the pressure.

***$\mathbf{F}_H$**=pressure at unit area of wall side.



Each box are stones,which are setted as fig.Friction force is horizontal colliding of each stones at the contacting point(P), Note $\mathbf{F}_H$ acts to slump yellow stone. While $\mathbf{F}_V$ (vertical gravity force due to mass of n stones)acts to intercept slumping.

Torque force around Q is,...
$(F_V/2n)L\cos\theta > (F_H/n)L\sin\theta$ ..no slump
$F_V/F_H = 2\tan\theta$ .....critical to slump
$\tan\theta \sim 4$? in the fig. → $F_V/F_H \sim 8$??

Note slumping is also caused by fragility of stone matter.As for also this problem, readers must ask the experts for the details.