MARINE ENGINEERING

By

Prof. Abdus Samad

IIT Madras

Lecture7

Conduction

This is the first conduction. I already told the conduction means particles are not moving. Particles are resonance only moving. If you have lots of free electron, for example, metal will have lots of free electron. So, if it is metal, the free electron will be helping to transfer heat from one point to another point.

So, material which are having higher electrical conductivity, those material will have more heat conductivity also. So, formula for heat conduction is just K A del T by L. And if you want to put in differential form, then it will be like this. Negative sign will be coming because whenever heat is transferring from hot body to cold body, your Q will be reduced. then dt by dx or dl will be there. If you are putting in terms of

differential form. So, if temperature and length is changing, so in that case, you have to put differential form. Otherwise, in normal case, like you are taking in a small slab and you are simply calculating, in that case, del T by del L will be okay. This is simplified form. Q is your heat flux, W, K thermal conductivity, W per meter cube.

So, this unit you have to remember. If I give you British thermal unit and other unit, then accordingly you have to change. T temperature difference, L is length, del T by del L called thermal gradient. So, del T by del L is higher, means higher heat transfer rate will be there. Del T means temperature difference.

If temperature difference is very high, then heat transfer rate will be high. L length means, which length? I have one slab and A, B, C, D, E, F, G, H okay front face is ABCD back set is G F E H okay now if I have higher temperature a G H C temperature may be high okay and the lower temperature D E F B D E F B surface temperature lower So, this surface and backside this surface.

One surface temperature high, another surface temperature low. Then which length will be considered? Your length will be CD if it is a simple rectangle block. So, your L will be CD actually. And what will be the area?

Area will be AGHC. So, area will be area length. Area will be AGHC. into hc okay this is a rectangular area uh because this is completely rectangular so both side area d e f b and c h g a all both area are equal i am assuming okay now conductivity of different material if you see this one copper is having very high conductivity silver is being further higher Aluminium is around 250, steel 60, water 0.6, air is very low.

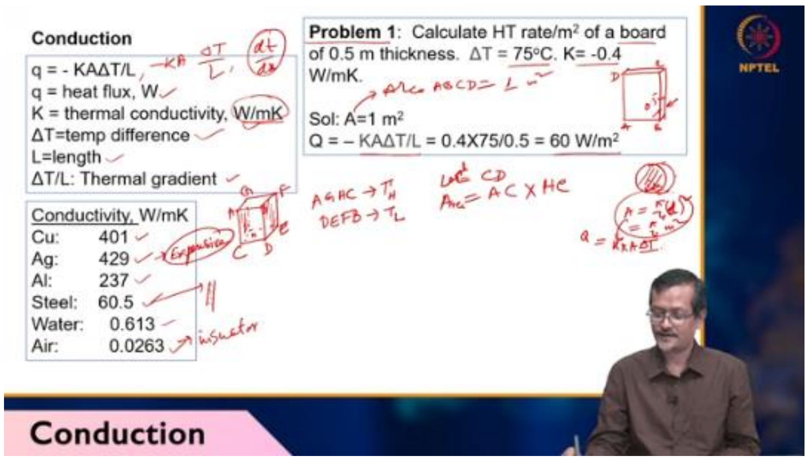
So, air is actually almost, it can be used as an insulator. So, that is why when thermoflask people will be designing, they will be putting two layers. Inside, they can put some small amount of air also fine. But if both metal sheets are there, inside vacuum, then very good. If it is not vacuum, if you are putting certain amount of air, it is still fine.

It will work as a good insulator. So, whenever you are designing in a heat exchanger, normal choice of metal will be copper. Why not AG? Silver is expensive. So that's why people will not make using silver.

And then another choice will be copper or aluminium. Gold also very high conductive material. So we also again will not use gold because it's expensive. Aluminium can be used in many places. It is used also but aluminium material is very soft.

okay so normal use will be copper okay iron sometime it is used for your heat exchanger applications but normally copper is the best choice even copper wire for electrical conductivity also copper wire used so your heat transfer application also copper pipes would be used normally so this will be giving more heat transfer rate okay now you see one problem here i calculate heat transfer rate per meter square of a board of 0.5 meter thickness del t given k given okay so here uh this board board means like i have to draw board like this and say this is flat and this is thickness okay and it is given 0.5 meter thickness so thickness means this is given 0.5 meter okay and area area is given 1 so a b c d if i take area so a b c d equals 1 meter square is given area A really and K is given 0.4 watt per meter square per meter K. So, if you put directly formula K A del T by L, so you are getting 60 watt per meter square. Now, instead of A 1 meter square we can give let us say in a circular shape for example, I can give this circular shape and you are getting you are transferring heat from this surface to the opposite surface.

So, then you can if I give the radius let us say this is circular face and radius is 1 meter then area will be pi by 4 into 1 meter square. So, this will be pi by 4 meter square, this much of area you are using. So, in that case your heat transfer rate will be, then in that case Q will be like K into A, this A you can put del T, del T divided by L. If you put this value, you can get Q value. So, for exam purpose, I can just twist little bit this sort of problem.



This is very simplest problem and this sort of problem will get in many books actually. And if you Google also, there will be so many websites to calculate this simple heat transfer problems. So, you can go through for some other problems also similar type for exam purpose or for assignment purpose.

114106534_Lecture7_English

by

Prof. Abdus Samad