Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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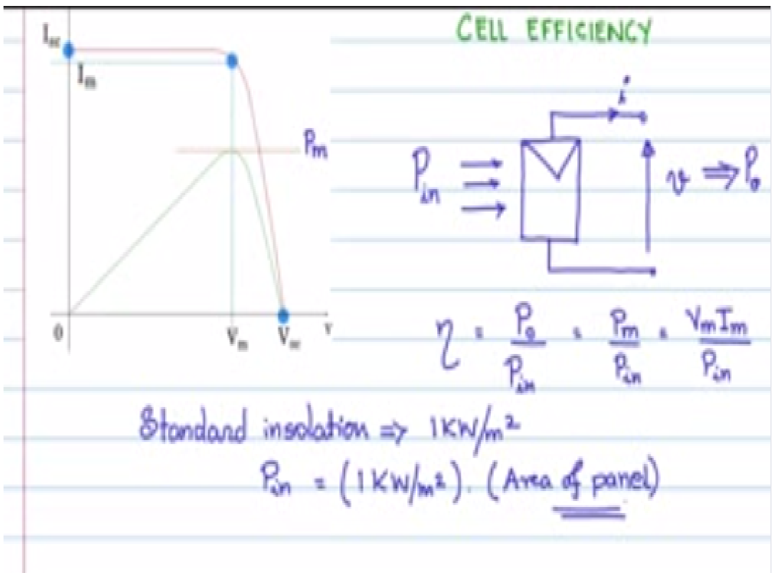

Consider the baby Cell as drawn here so it has the two terminals V and I, the input is the incident solar radiation, so what is the power input and what is the corresponding power output that this PV cell is capable of gives you an idea of efficiency which is given by P_0/P_{in} now which is equal to P_0 at peak power, so what is maximum power that the PV cell is capable of giving at any particular installation is this peak power P_m.

So we will call this one as P_m and this is what is the output of the PV cell by P_{in} and we know that P_m is nothing but V_m I_m/P_{in} now what is P_{in} , is that the standard insulation is one kilowatt per meter square and P_{in} is given by one kilowatt per meter square into area of panel, what is the area of the panel?

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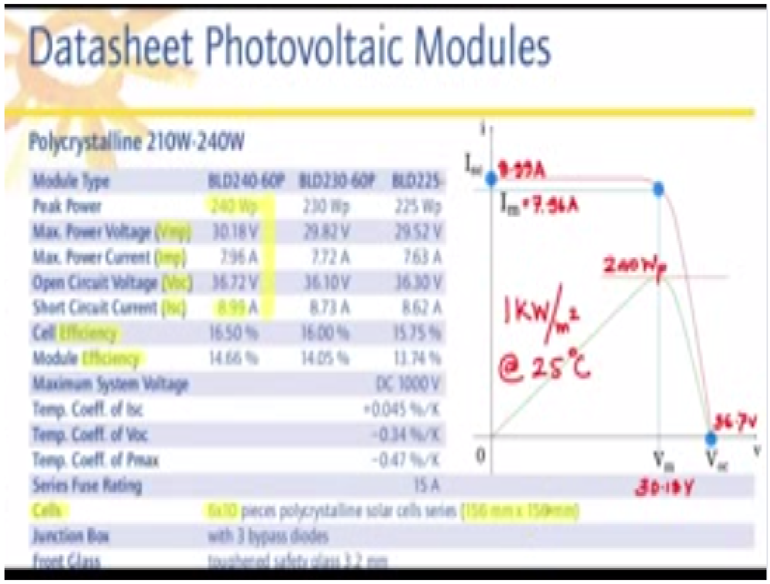

Go back to the data sheet, the data sheet look at this row the sense there are 6 x 10 pieces so the poly crystalline cell between 60 cells and each cell having this area has indicated 0.156 m x 0.156 m so let us use this in our calculation to arrive at what is power input case, so going back to the.

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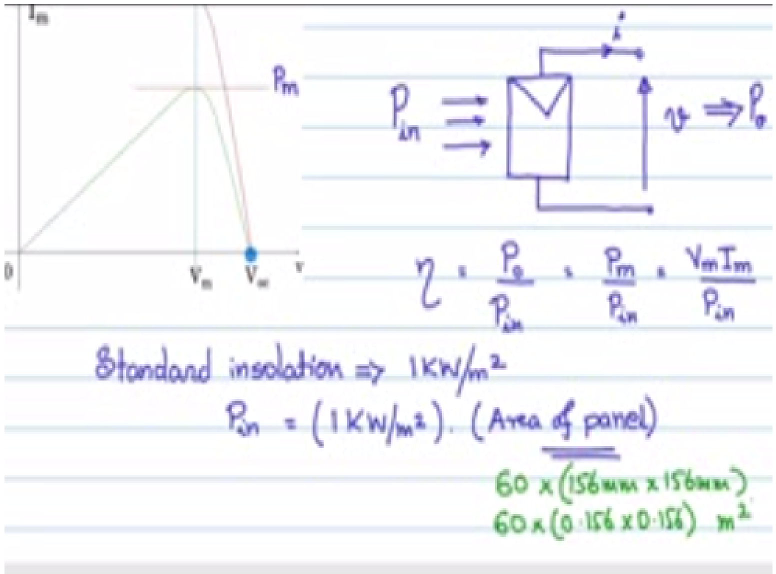

So you see the area of the panel is 16 numbers of the cells each having 156 mm x 156 mm area so let us convert them to meters so it is 16 x 0.156 x 0.15 6 meter square.

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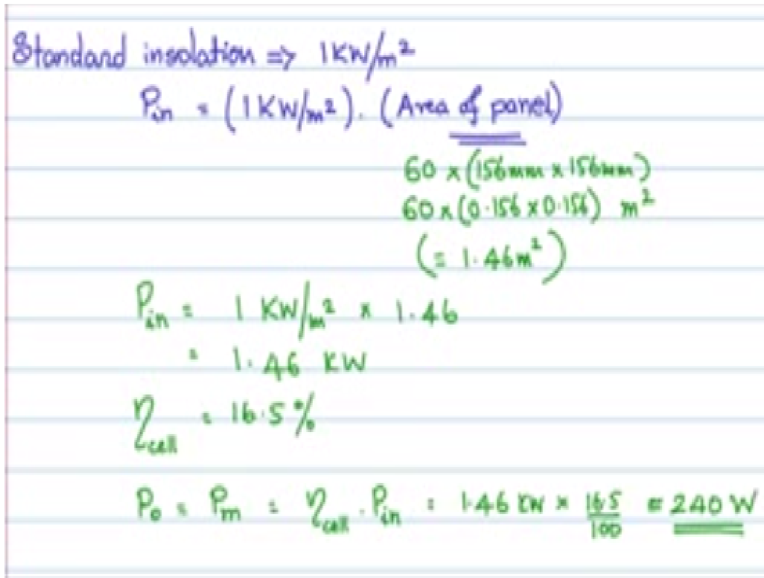

This turns out to be 1.46 meter square so P_{in} is one kilowatt per meter square into 1.46 which is 1.46 KW. Now the cell efficiency from the data sheet is given as 16.5% before P0 = P_m which is the max power will be efficiency of the cell into P_m which is 1.46 KW x 16.5/100 which is equal to about approximately 240W.

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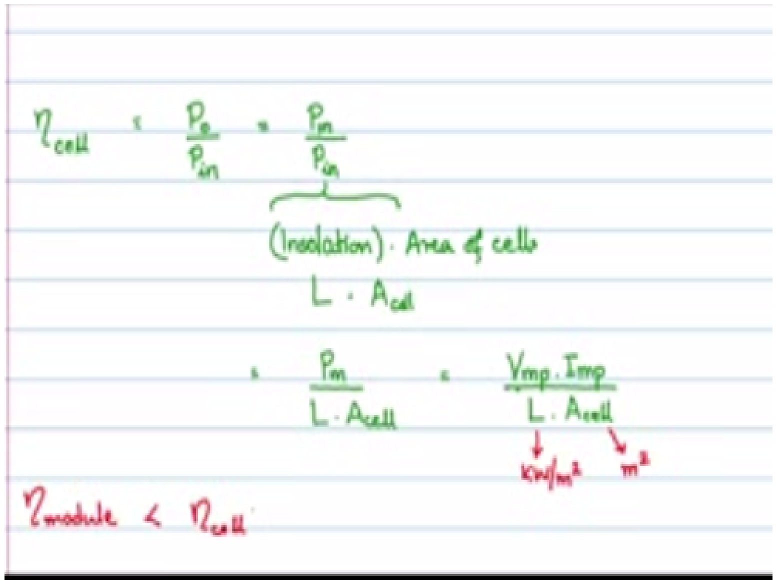

Therefore a cell efficiency I call it as efficiency subscript cell is given by the output power delivered by the PV cell to the incident input solar power, the output power at the peak power point is named as P_m we know that divided by P_{in}, and what is a P_{in}? P_{in} is nothing but insulation which is given in kilo watt per meter square into area of cell the total area of the cells of the cells, we shall use the symbol L for insulation into the area of the cells which is area cell like this and thereby therefore after substituting you see that P_m /L which is kilo watt per meter square into the area of the cells will give you the input incident power.

Or further in terms of the peak power voltage and the currents with a V_m V_{mp} x I_{mp} /L x A_{cell} the insulation is in kilowatt per meter square the area of the cell is in meter square, so this is the cell efficiency however one should note that the module efficiency is not the same as the cell efficiency, efficiency of the whole PV module actually is less than the efficiency of the cell, what is the difference between those two? Basically it is in the area of the cell and the area of the module now let us look at this difference.

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Consider a PV panel this is actually a 6 x 10 cells panel to each is a cell, this portion as I am indicating with the P mouse cursor is a cell there are 10 such in this column and there are 6 horizontal, now if you look at a much more closer view you will see that the cells though in the cells have some space is between, the module is actually encapsulating all these cells there are spaces at the rim the rim itself is occupying some area there are some spaces in between the cells.

Now all these area are not affected area and the solar insulation if even if it falls on this area is actually not captured, therefore the entire module is actually having a bigger area accommodating all these gaps and cases as compared to the pure cell area alone and therefore the module efficiency is definitely going to be lower than the cell efficiency.

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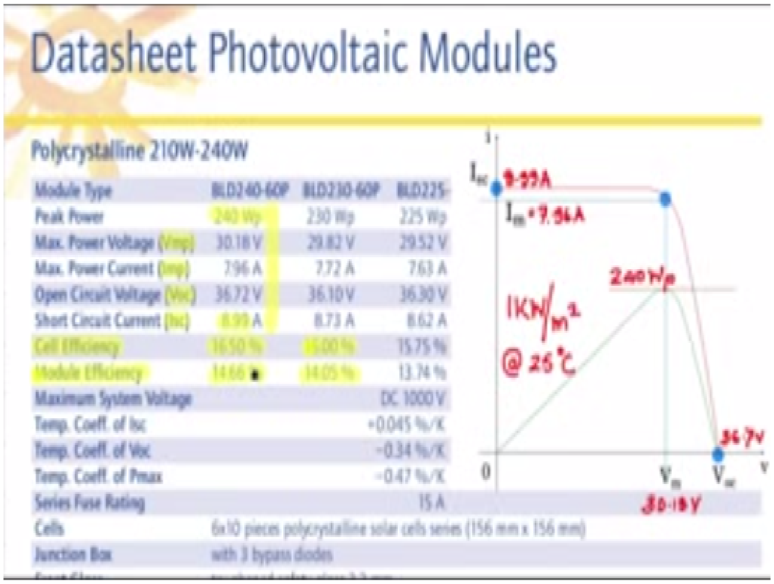

If you come back to the datasheet and we will look at the data sheet here you have the cell efficiency and you see the cell efficiency is 16.5% and where are the module efficiency is actually 14.66% it is so in all types of panels because the module area is higher than the fuel cell area and most of the time the peak power and all these other rating the power rating as mentioned earlier here or with respect to the Pure cell area and pure cell efficiency.

Over a practical purposes whenever you are calculating for a given application the module efficiency is a much more conservative and better value to take because you will be using the more practical efficiency.