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| CAE simulation 6 |

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Subject : Turbine blade analysis

Name : HanMinwoong

**1. Change the material from aluminum alloy to structural steel. Explain differences in the temperature distribution and maximum stress with values of thermal conductivity(k), thermal expansion coefficient (), and elastic modulus(E).**

**Table 1. Comparison of equivalent stress according to the material**

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| --- | --- |
| **Aluminum alloy** | **Structural steel** |
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As can be seen in the **Table 1**, structural steel has higher equivalent stress compared to the aluminum alloy when it comes to heat transfer analysis. To get proper analysis, comparison of thermal properties between structural steel and aluminum alloy (6061-T6) must be analyzed.

**Table 2. Comparison of thermal properties between structural steel and aluminum alloy**

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Structural steel has elastic modulus, which is about three times larger than that of aluminum alloy, which is . And thermal expansion coefficient of aluminum alloy is higher than that of structural steel, which is about twice higher value. That means that in the same thermal condition, structural steel has higher thermal stress than aluminum alloy. And, in terms of , under the same length and thermal conditions, a material with a larger thermal expansion coefficient will have a larger strain. As can be seen in **Table 3**, aluminum alloy has greater length deformation.

**Table 3. Comparison of total deformation according to the material**

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| **Aluminum alloy** | **Structural steel** |
|  |  |

**2. Try a transient heat transfer (initial temperature of ) and transient structural analysis. Discuss on the difference between the steady and transient analysis.**

In the transient heat thermal, the result shows that it takes about only for reach to the steady state of equivalent thermal stress. As same with steady thermal condition, each side of the blade was set with frictionless support. And the result is as follows:

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**Figure 1. Equivalent stress in transient heat thermal condition (steady state)**

**Figure 1** shows that final equivalent stress with transient heat thermal condition, which is the equivalent stress in the steady state, is equal to that with steady thermal condition. However, in the transient condition, we are interested in the change of equivalent stress. The result with tabular data is as follows:

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**Figure 2. Transient heat: temperature result**

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**Figure 3. Detailed tabular data**