INTISARI

Pertumbuhan ekonomi yang begitu pesat menuntut konektivitas orang dan barang yang semakin cepat, namun kemacetan yang terjadi di kota besar menyebabkan kerugian yang signifikan. Kereta cepat dianggap solusi untuk meningkatkan mobilitas dan konektivitas antar wilayah, dan juga mendukung pertumbuhan ekonomi dan daya saing nasional. Pengembangan dan pembuatan Kereta Cepat Merah Putih milik PT INKA membutuhkan penelitian mendalam dari berbagai aspek, salah satunya kenyamanan termal penumpangnya. Penelitian ini mengkaji pengaruh perubahan dan pengaturan geometri *ducting*, penambahan *turbulance maker* dan letak *return duct* terhadap keseragaman debit udara pada *diffuser ducting* Kereta Cepat Merah Putih (KCMP).

Penelitian ini melibatkan simulasi *Computational Fluid Dynamics* (CFD) dengan menggunakan perangkat lunak ANSYS Fluent 2020 R2 untuk memeriksa dan menganalisis aliran fluida, distribusi temperatur, dan kecepatan udara di dalam kabin kereta penumpang. Variasi dilakukan terhadap geometri *ducting* bertingkat, penambahan *air barrier*, dan luas *cross-sectional* area untuk mengatasi ketidakseragaman *mass flow rate* pada tiap *diffuser*.

Hasil simulasi *supply duct* bertingkat menunjukkan variasi geometri tidak signifikan mempengaruhi *mass flow rate*, kecuali pada *diffuser* yang belum terkonfigurasi baik. Keseragaman *mass flow rate* dipengaruhi konfigurasi *diffuser*. Variasi 2 dengan lebar 421,824 tanpa area transisi meningkatkan keseragaman dan memudahkan manufaktur. Tambahan *turbulance maker* dan perubahan *cross-sectional* area pada variasi 9 memberikan hasil terbaik dengan indeks ketidakseragaman 0,0829. *Supply duct* bertingkat memenuhi standar kenyamanan termal, meski ketidakseragaman temperatur (0,041) dan kecepatan udara (0,643) lebih tinggi dibanding *ducting* datar. *Return duct* tepi meningkatkan kenyamanan dengan indeks ketidakseragaman temperatur 0,563 dan kecepatan udara 0,037.

Kata kunci : ***Ducting AC, Air Barrier, Step Ducting, Computer Fluid Dynamics, Thermal Comfort***

ABSTRACT

Rapid economic growth demands faster connectivity of people and goods, but congestion in big cities causes significant losses. Fast trains are considered a solution to improve mobility and connectivity between regions, and also support economic growth and national competitiveness. The development and manufacture of PT INKA's Merah Putih Fast Train requires in-depth research from various aspects, one of which is the thermal comfort of its passengers. This study examines the effect of changes and arrangements of ducting geometry, the addition of turbulence makers and the location of return ducts on the uniformity of air discharge in the Merah Putih Fast Train (KCMP) ducting diffuser.

This research involves Computational Fluid Dynamics (CFD) simulations using ANSYS Fluent 2020 R2 software to examine and analyze fluid flow, temperature distribution, and air velocity inside the passenger train cabin. Variations were made to the multilevel ducting geometry, the addition of air barriers, and the cross-sectional area to overcome the non-uniformity of mass flow rate in each diffuser.

The results of the multilevel supply duct simulation show that geometry variations do not significantly affect the mass flow rate, except for the diffuser which is not well configured. Mass flow rate uniformity is influenced by the diffuser configuration. Variation 2 with a width of 421.824 without a transition area improves uniformity and facilitates manufacturing. The additional turbulance maker and the change in cross-sectional area in variation 9 gave the best results with a non-uniformity index of 0.0829. The multilevel supply duct meets the thermal comfort standard, although the temperature (0.041) and air velocity (0.643) non-uniformities are higher than the flat ducting. The edge return duct improves comfort with a temperature non-uniformity index of 0.563 and air velocity of 0.037.

Keywords : ***Ducting AC, Air Barrier, Step Ducting, Computer Fluid Dynamics, Thermal Comfort***