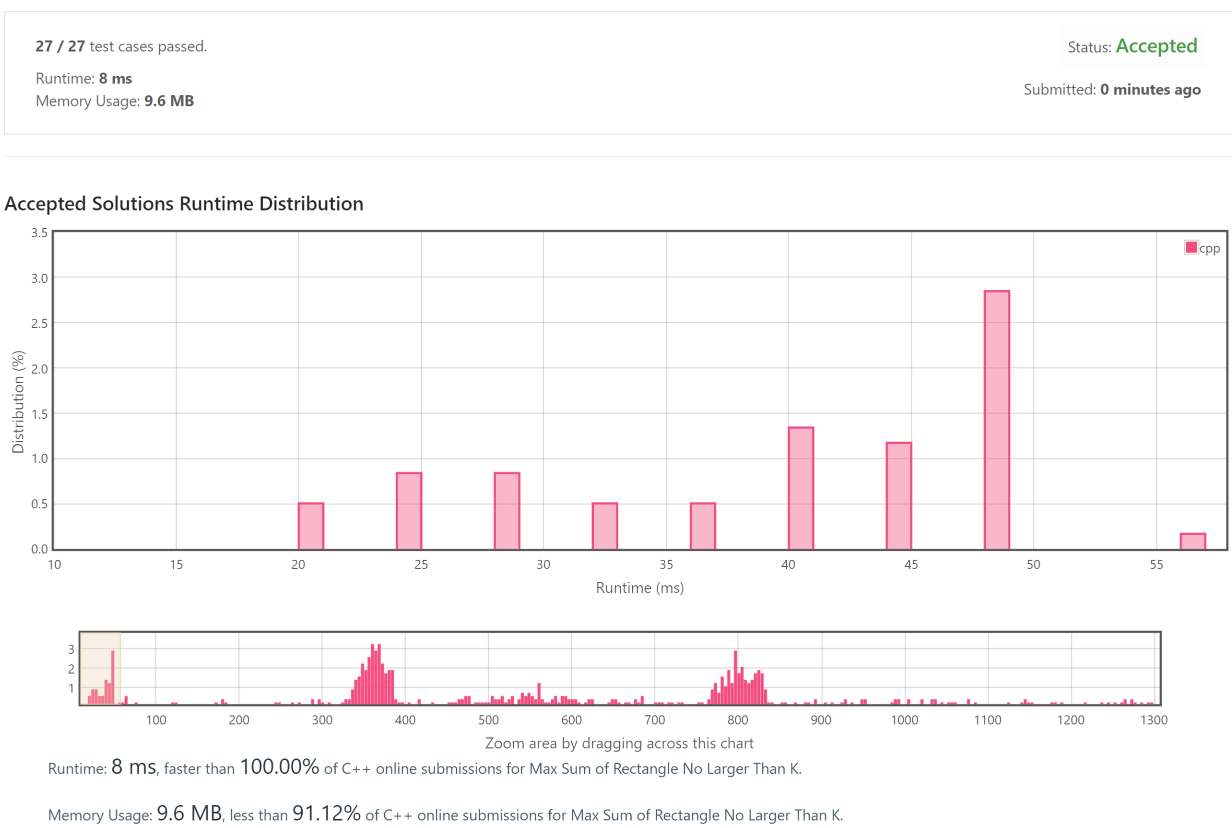
wlog assume $m \leq n$.
Enumerate the top edge and the bottom edge in $O(m^2)$. Then we need to solve the 1D problem (1099. Two Sum Less Than K), by prefix sum and sorting in $O(\text{sort}(n))$, or expected $O(n)$. The total running time is $O(m^2 \cdot \text{sort}(n))$ or $O(m^2 n)$. see my article https://leetcode-cn.com/problems/max-sum-of-rectangle-no-larger-than-k/solution/onm2-c-16ms-beats-100-by-hqztrue-wlyz/.

Remark.
1. lower bound: the problem of finding the maximum sum rectangle (which is APSP-hard [1]) can be reduced to this problem, so it is hard to solve this in $O(n^{3-\epsilon})$. https://en.wikipedia.org/wiki/Maximum_subarray_problem
2. can we modify the slightly subcubic algorithm for the maximum sum rectangle problem [2], and also get slightly subcubic running time?
3. the testcases are very weak (update: the constraints have been reduced).



References

[1] Arturs Backurs, Nishanth Dikkala, and Christos Tzamos. Tight hardness results for maximum weight rectangles. In *43rd International Colloquium on Automata, Languages, and Programming (ICALP 2016)*, 2016.

[2] Tadao Takaoka. Efficient algorithms for the maximum subarray problem by distance matrix multiplication. *Electronic Notes in Theoretical Computer Science*, 61:191–200, 2002.