**A. SCENE:**
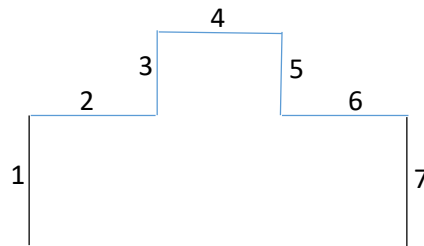


Top view of the observed scene

The observed scene contains a building showing a set of 7 vertical facades. Facades 1 and 7 are parallel and in front of eachother. Facedes 2 and 6 are coplanar, and perpendicular to facades 1 and 7. Facade 3 is parallel to facades 1 and 7, while the central facade 4 is parallel to facades 2 and 6. Facade 5 is occluded.

All the **windows** in facades 1, 2 and 6 are of **equal width**. The common width of the windows is 1 m. However, nothing can be assumed about the ornements regularly placed just under the roof cornice.

**B. IMAGE:** An image of the building is taken by a zero-skew camera. Natural camera **can not** be assumed.

**C. ASSIGNMENT:** write and test a Matlab program that analyzes the Image in order to extract the information items listed below.

**1. Image feature extraction and selection:**

Combining the learned techniques, find edges, corner features and straight lines in the image. Then manually select those features and those lines, that are useful for the subsequent steps.
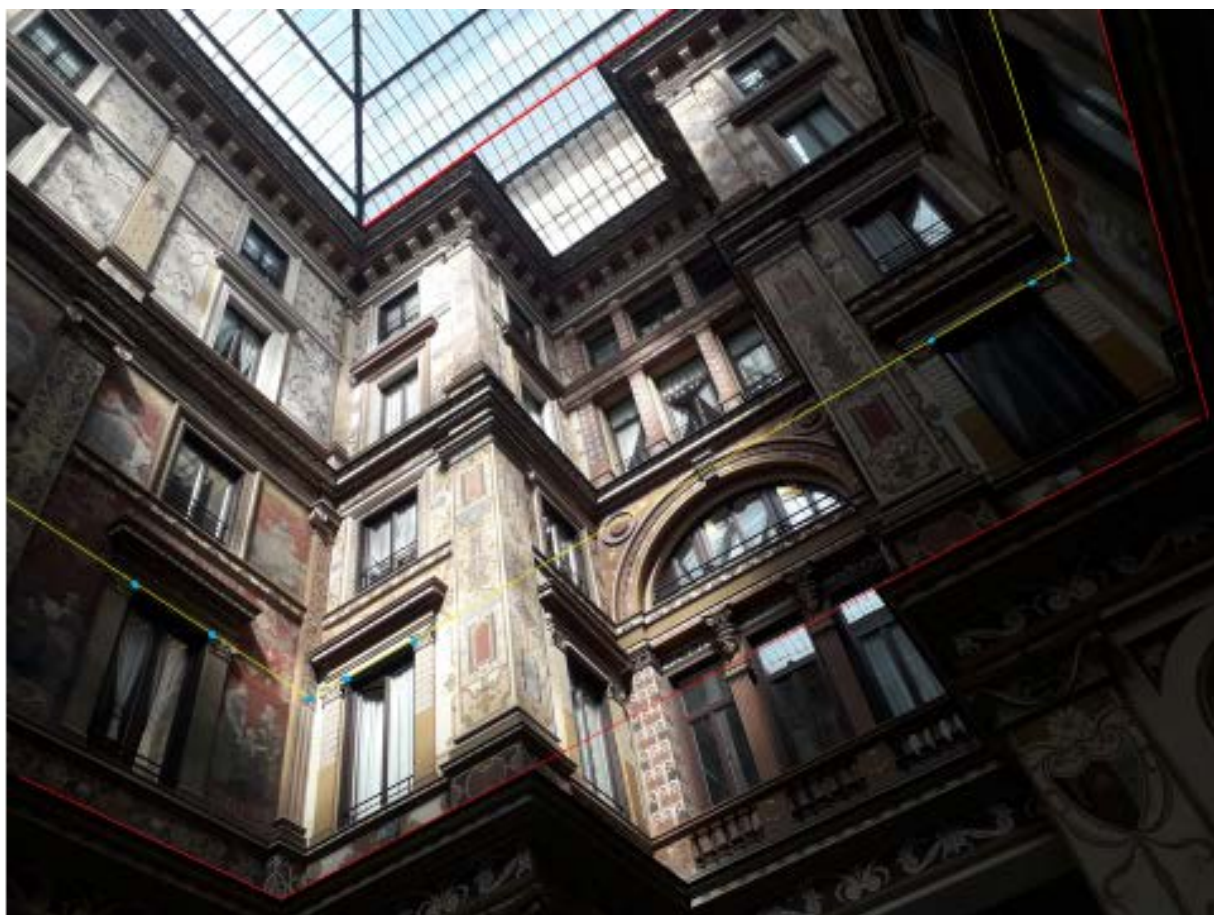
**2. Geometry:**

2.1 Find two horizontal vanishing points and one vertical vanishing point.
2.2 Look at image below and consider the horizontal section of facades 1, 2 and 6 , depicted in yellow: **metrically reconstruct** this horizontal section*, so as to determine the relative coordinates of features points indicated in blue. These point features are placed (i) at the intersections between facades 1 and 2 and between facades 6 and 7, and (ii) in correspondence of borders of the windows.
2.3 Estimate the calibration matrix **K** of the camera. Assume the camera is zero-skew, but not natural.
2.4 Use the knowledge of **K** to rectify also a vertical facade, as, e.g., facade 1 or 4 or 2+6.
2.5 Fix a suitable reference frame attached to the building, and localize the camera relative to the fixed reference
2.6 OPTIONAL: Make a consistency check by comparing the obtained results to those obtained from the second image provided.

**HINT**: use normalized image coordinates to reduce numerical errors (e.g., set image size to 1)
**ATTENTION**: approaches that address accuracy issues in point 2.2 are highly appreciated.

*Feel free to reconstruct, instead, any other horizontal section of facades 1, 2 and 6, provided it crosses the borders of the windows. E.g. the **red section** is **not** suitable, as it does not cross the window borders

Image