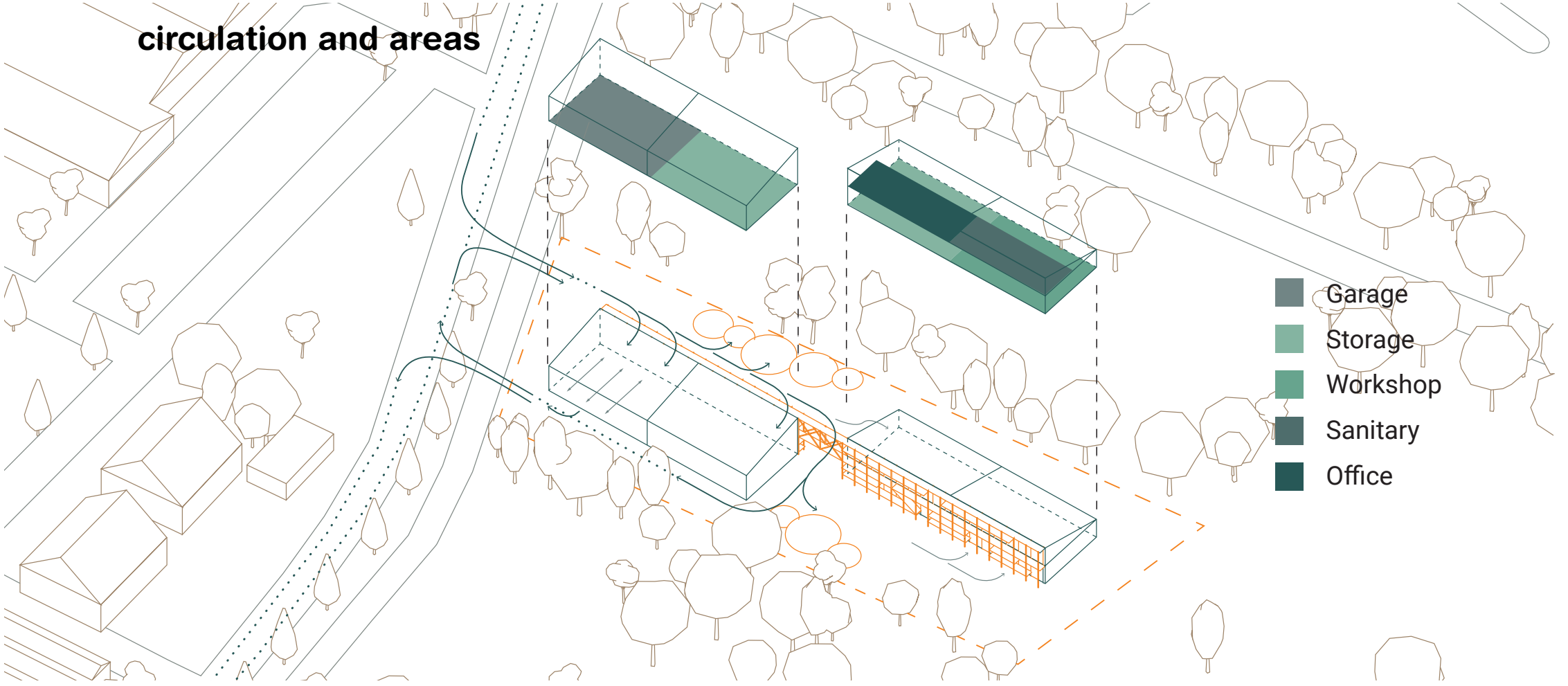circulation and areas