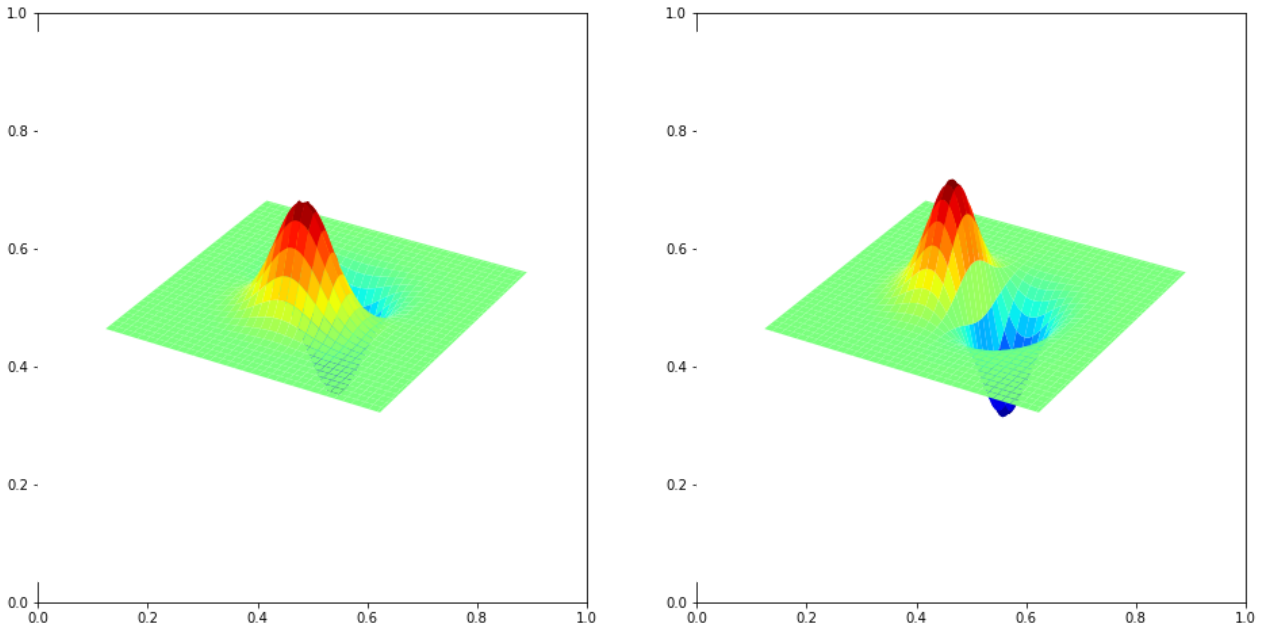
Name : Gajaanan S. Index No : 190185D

In [15]:

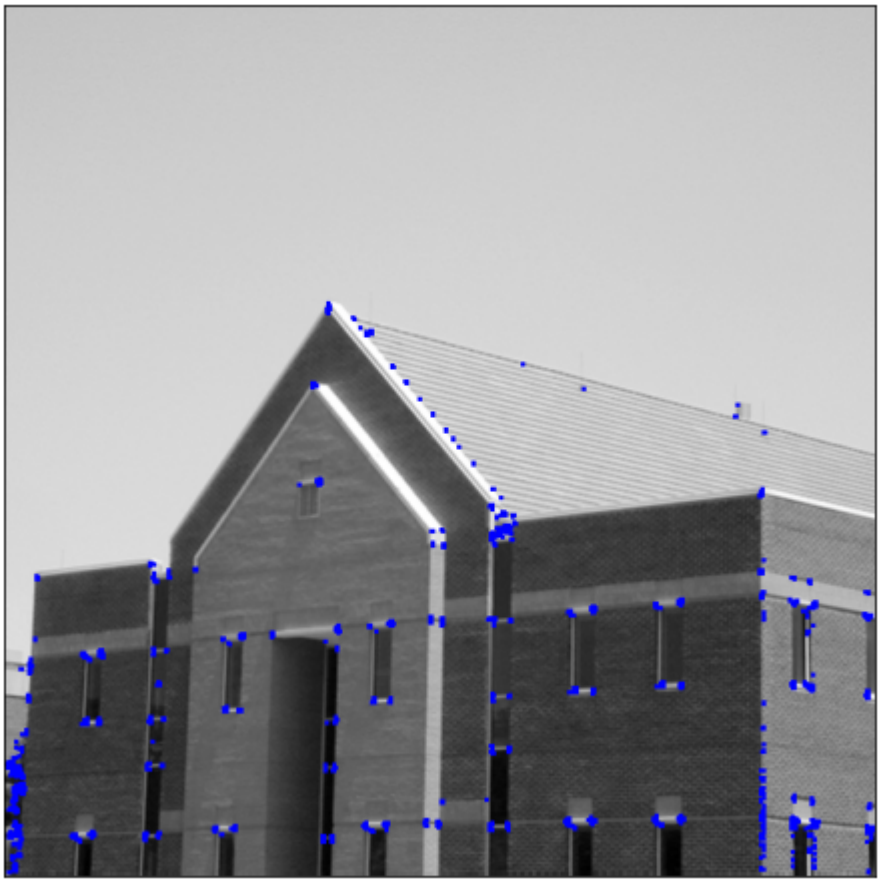
```
#Q1
import cv2 as cv
import numpy as np
from mpl_toolkits.mplot3d import Axes3D
from matplotlib import cm

fig, ax = plt.subplots (1,2, figsize=(16,8))
ax1 = fig.add_subplot (121, projection='3d')
ax2= fig.add_subplot (122, projection='3d')
delta = 0.1
xx, YY = np.meshgrid(np.arange(-5, 5 + delta, delta),np.arange(-5, 5 + delta, delta))
sigma = 1

g= np.exp(-(xx**2 + YY**2)/(2*sigma**2))
g /= np.sum(g)
sobel_v = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]], dtype=np.float32)
g_x= cv.filter2D(g, -1, sobel_v)
sobel_h= np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]], dtype=np.float32)
g_y = cv.filter2D(g, -1, sobel_h)
surf1 = ax1.plot_surface(xx, YY, g_x, cmap=cm.jet, linewidth=0, antialiased=True)
surf2 = ax2.plot_surface(xx, YY, g_y, cmap=cm.jet, linewidth=0, antialiased=True)
ax1.axis('off')
ax2.axis('off')
plt.show()
```



In [12]:

```
#Q2
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt

filename = 'building.tif'
img = cv.imread(filename)
gray = cv.cvtColor(img,cv.COLOR_BGR2GRAY)
gray = np.float32(gray)
dst = cv.cornerHarris(gray,2,3,0.04)
```

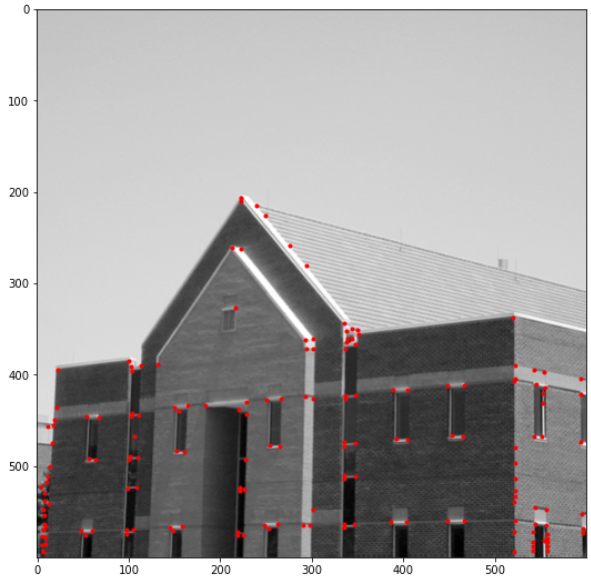
```
dst = cv.dilate(dst,None)
img[dst>0.01*dst.max()]=[0,0,255]
plt.figure(figsize=(8,8))
plt.imshow(img)
plt.xticks([]), plt.yticks([])
plt.show()
```

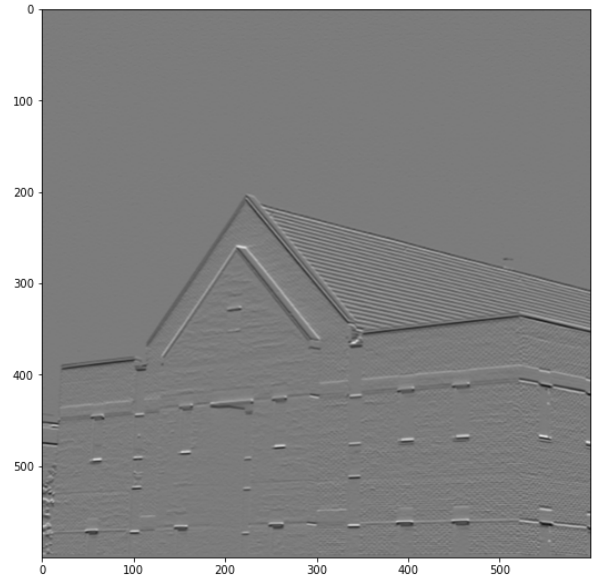


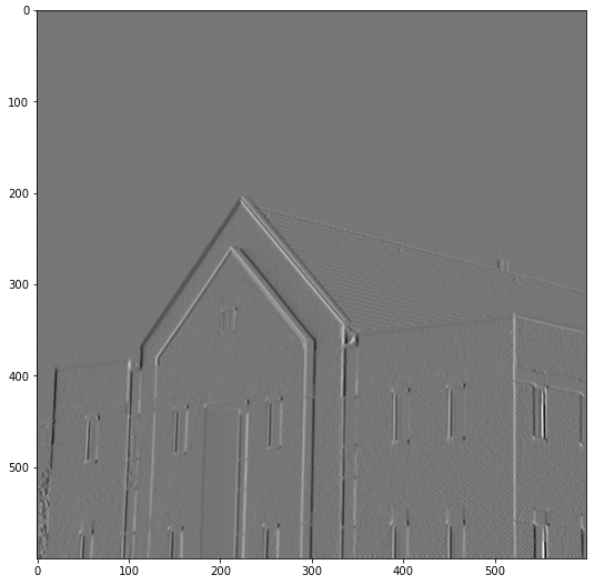
In [18]:

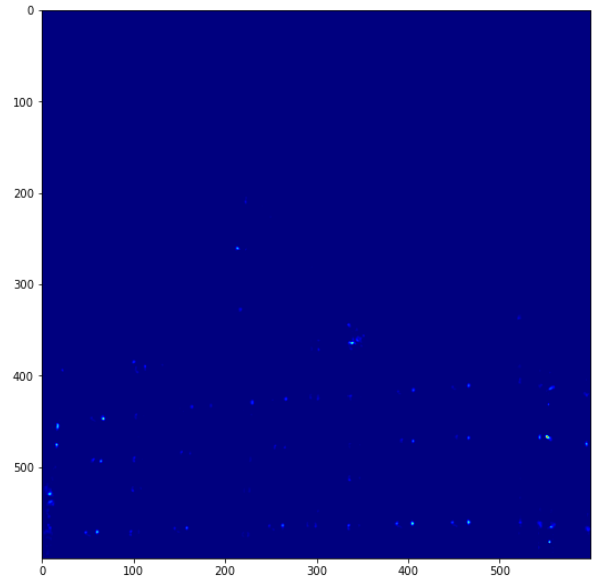
```
#Q3
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt
from skimage.feature import peak_local_max

im = cv.imread('building.tif', cv. IMREAD_COLOR)
assert im is not None

I = cv.cvtColor(im,cv.COLOR_BGR2GRAY)
I = np.float32(I)
sobel_v = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]], dtype=np. float32)
sobel_h = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]], dtype=np. float32)
Ix = cv. filter2D(I, -1, sobel_v)
Iy = cv.filter2D(I, -1, sobel_h)
sigam = 3
ksize = 7
m11 = cv.GaussianBlur (Ix*Ix, (ksize, ksize), sigma)
m12 = cv.GaussianBlur (Ix*Iy, (ksize, ksize), sigma)
m21 = m12
m22= cv.GaussianBlur (Iy*Iy, (ksize, ksize), sigma)

det = m11*m22 - m12*m21
```

```
trace = m11 + m22
alpha = 0.04
R= det - alpha*trace**2

R[R < 1e8] = 0
coordinates = peak_local_max(R, min_distance=2)

fig, ax = plt.subplots (2,2, figsize=(20, 20))
ax[0,0].imshow(im, cmap='gray')
ax[0,0].plot(coordinates [:, 1], coordinates [:, 0], 'r.')
ax[0,1].imshow(Ix + 127, cmap='gray')
ax[1,0].imshow(Iy + 127, cmap='gray')
ax[1,1].imshow(R+ 127, cmap=cm.jet)
plt.show()
```









In [9]:

```
#Q4
import numpy as np
import cv2 as cv
from matplotlib import pyplot as plt
img = cv.imread('building.tif',0)
```

```
edges = cv.Canny(img,100,200) #image low threshold, high threshold
plt.figure(figsize=(15,15))
plt.subplot(121),plt.imshow(img,cmap = 'gray')
plt.title('Original Image'), plt.xticks([]), plt.yticks([])
plt.subplot(122),plt.imshow(edges,cmap = 'gray')
plt.title('Edge Image'), plt.xticks([]), plt.yticks([])
plt.show()
```