uniquely determined by the following conditions:

$$\begin{aligned}
w_i^0(x_j) &= \delta_{ij}, \quad 1 \leq j \leq N,\ 1 \leq i \leq N \\
(w_i^0)'(x_j) &= 0, \quad 0 \leq j \leq N+1,\ 1 \leq i \leq N \\
w_i^1(x_j) &= 0, \quad 1 \leq j \leq N,\ 0 \leq i \leq N+1 \\
(w_i^1)'(x_j) &= \delta_{ij}, \quad 0 \leq j \leq N+1,\ 0 \leq i \leq N+1
\end{aligned}$$

with $\delta_{ij} = 1$ iff $i = j$ and $\delta_{ij} = 0$ if $i \neq j$. Some of these functions are displayed in Figure 19.4. The function $w_i^0$ is given explicitly by

$$w_i^0(x) = \frac{1}{h^3}(x - (i-1)h)^2((2i+1)h - 2x), \quad (i-1)h \leq x \leq ih,$$

$$w_i^0(x) = \frac{1}{h^3}((i+1)h - x)^2(2x - (2i-1)h), \quad ih \leq x \leq (i+1)h,$$

for $i = 1, \ldots, N$. The function $w_j^1$ is given explicitly by

$$w_j^1(x) = -\frac{1}{h^2}(ih - x)(x - (i-1)h)^2, \quad (i-1)h \leq x \leq ih,$$

and

$$w_j^1(x) = \frac{1}{h^2}((i+1)h - x)^2(x - ih), \quad ih \leq x \leq (i+1)h,$$

for $j = 0, \ldots, N+1$. Furthermore, for every function $v \in V_N^1$, we have

$$v(x) = \sum_{i=1}^{N} v(ih)w_i^0(x) + \sum_{j=0}^{N+1} v'jih)w_j^1(x), \quad x \in [0,1].$$

If we order these basis functions as

$$w_0^1, w_1^0, w_1^1, w_2^0, w_2^1, \ldots, w_N^0, w_N^1, w_{N+1}^1,$$

we find that if $c = 0$, the matrix $A$ of the system $(*)$ is tridiagonal by blocks, where the blocks are $2 \times 2$, $2 \times 1$, or $1 \times 2$ matrices, and with single entries in the top left and bottom right corner. A different order of the basis vectors would mess up the tridiagonal block structure of $A$. We leave the details as an exercise.

Let us now take a quick look at a two-dimensional problem, the bending of an elastic membrane.