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!  For a waveguide mode: compute the H-field on P2 nodes from the E-field using
P2 and P3 data
!  Incoming Ez components are defined in NumBAT form: \hatEz=-i \beta Ez

subroutine get_H_field_p3 (k_0, beta1, mat_T, E_field_el, Ez_field_el_P3, H_fiel
d_el)

   use numbatmod

   double precision k_0, mat_T(2,2)
   complex(8) beta1
   complex(8) E_field_el(3,P2_NODES_PER_EL)

   !        !  P3 Ez-field
   complex(8) Ez_field_el_P3(10)
   complex(8) H_field_el(3,P2_NODES_PER_EL)

   !     Local variables

   double precision vec_grad_P2(2,P2_NODES_PER_EL)
   double precision vec_grad_P3(2,P3_NODES_PER_EL),  omega
   integer(8) inod, jnod
   complex(8)  z_tmp1, z_tmp2
   complex(8) Maxwell_coeff

   !      By applying the Maxwell's equations to the E-field of a waveguide mode
, we get:
   !      H_x = [-beta*E_y + D(E_z,y)] * Coefficient
   !      H_y = [ beta*E_x - D(E_z,x)] * Coefficient
   !      H_z = [ D(E_y,x) - D(E_x,y)] * Coefficient

   H_field_el = C_ZERO

   do inod=1,P2_NODES_PER_EL
      z_tmp1 = -beta1 * E_field_el(2,inod) * C_IM_ONE
      z_tmp2 =  beta1 * E_field_el(1,inod) * C_IM_ONE
      H_field_el(1,inod) = H_field_el(1,inod) + z_tmp1
      H_field_el(2,inod) = H_field_el(2,inod) + z_tmp2
   enddo

   do inod=1,P2_NODES_PER_EL
      !       vec_grad_p2: contains the gradients of all 6 basis polynomials at
the node inod
      call phi2_grad(inod, P2_NODES_PER_EL, mat_T, vec_grad_P2)
      call phi3_grad_p2(inod, P3_NODES_PER_EL, mat_T, vec_grad_P3)

      do jnod=1,P3_NODES_PER_EL
         z_tmp1 =  vec_grad_P3(2,jnod) * Ez_field_el_P3(jnod)
         z_tmp2 = -vec_grad_P3(1,jnod) * Ez_field_el_P3(jnod)
         H_field_el(1,inod) = H_field_el(1,inod) + z_tmp1
         H_field_el(2,inod) = H_field_el(2,inod) + z_tmp2
      enddo

      do jnod=1,P2_NODES_PER_EL
         z_tmp1 = -vec_grad_P2(2,jnod) * E_field_el(1,jnod)
         z_tmp2 =  vec_grad_P2(1,jnod) * E_field_el(2,jnod)
         H_field_el(3,inod) = H_field_el(3,inod) + z_tmp1+z_tmp2
      enddo

   enddo
```



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   !     The curl of the E-field must be multiplied by a coefficient in order to
 get the H-field
   !     For example: Maxwell_coeff = 1/ (i * k0 * mu)

   ! TODO: check the scaling here
   omega = k_0 * SI_C_SPEED

   !       Maxwell_coeff = 1.0d0 / (C_IM_ONE* omega)
   Maxwell_coeff = 1.0d0 / (C_IM_ONE* omega * SI_MU_0)

   !       Maxwell_coeff = 1.0d0 / (C_IM_ONE* k_0)

   H_field_el = H_field_el * Maxwell_coeff

end
```