openings in room boundaries (e.g. doorways). Moreover, the absorption of sound by a particular shape depends on the angle of incidence and frequency of the sound wave.

The *description* field specifies a textual description node characteristics. This information is beneficial for authoring, and may be used by optional browser-specific user interfaces that present users with more detailed information about active time-dependent behavior.

The *enabled* field enables and disables acoustic effects.

The *diffuse* field describes the diffuse coefficient of sound reflection. This is one of the physical phenomena of sound that occurs when a sound wave strikes a plane surface, and part of the sound energy is reflected back into space in multiple directions.

The *refraction* field describes the sound refraction coefficient of a medium, which determines the change in propagation direction of a sound wave when it obliquely crosses the boundary between two mediums where its speed is different. These relationships are described by Snell's Law.

The *specular* field describes the specular coefficient of sound reflection, which is one of the physical phenomena of sound that occurs when a sound wave strikes a plane surface. Part of the sound energy is directly reflected back into space, where the angle of reflection is equal to the angle of incidence.

## 12.4.2 Appearance

```
Appearance : X3DAppearanceNode {
  SFNode   [in,out] acousticProperties NULL    [AcousticProperties]
  SFFloat  [in,out] alphaCutoff         0.5     [0,1]
  SFString [in,out] alphaMode           "AUTO"  ["AUTO", "OPAQUE", "MASK", "BLEND"]
  SFNode   [in,out] backMaterial        NULL    [X3DOneSidedMaterialNode]
  SFNode   [in,out] fillProperties      NULL    [FillProperties]
  SFNode   [in,out] lineProperties      NULL    [LineProperties]
  SFNode   [in,out] material            NULL    [X3DMaterialNode]
  SFNode   [in,out] metadata            NULL    [X3DMetadataObject]
  SFNode   [in,out] pointProperties     NULL    [PointProperties]
  MFNode   [in,out] shaders             []      [X3DShaderNode]
  SFNode   [in,out] texture             NULL    [X3DTextureNode]
  SFNode   [in,out] textureTransform    NULL    [X3DTextureTransformNode]
}
```

The Appearance node specifies the visual properties of geometry. The value for each of the fields in this node may be NULL. However, if the field is non-NULL, it shall contain one node of the appropriate type.

The *acousticProperties* field, if specified, shall contain an AcousticProperties node describing coefficients related to the physical propagation of sound for various materials.

The *alphaCutoff* field provides a threshold value for pixel rendering as either transparent or opaque, used when *alphaMode* has value MASK.

The *alphaMode* field determines how the final transparency value is computed for each pixel. The final alpha value is determined by various properties of the material and textures (following the lighting model equations given in the 17 Lighting component) or by custom shaders, when these are used (see 31 Programmable shaders component). The following values of *alphaMode* are allowed:

- AUTO — the browser automatically determines the alpha treatment based on the material *transparency*, optionally taking into account the alpha channel of the textures that affect the final alpha value. In effect, this mode means that browser auto-detects which of the algorithms described below: OPAQUE, MASK or BLEND. This mode corresponds to rendering according to the X3D version 3 specification.
- OPAQUE — the shape is rendered as opaque, and the final alpha value is ignored.
- MASK — the shape is rendered using alpha testing. When the final alpha value is less than *alphaCutoff*, the relevant pixel is discarded (i.e. treated as fully transparent). When the final alpha value is greater than or equal to *alphaCutoff*, the relevant pixel is rendered as if it was fully opaque. Note that the *alphaCutoff* value matters only when *alphaMode* is MASK, or when when *alphaMode* is AUTO and browser auto-detected that the MASK mode is the most appropriate. Note that if custom shader nodes are applied (see 31 Programmable shaders component) then implementation of this technique may require appropriate code in the user-provided shader content.
- BLEND — the shape is rendered using blending techniques. Ideally, the shape is rendered in front of other shapes and the background behind it, mixing the shape color proportionally to the final alpha value. The final alpha value value 0.0 results in a fully transparent pixel, value 1.0 results in a fully opaque pixel, and in-between values results in a partially transparent pixel. ~~Real-time implementations typically employ GPU capabilities to activate the blending algorithm, and may use sorting techniques to turn off depth tests.~~

The *backMaterial* field, if specified, shall contain a Material, PhysicalMaterial or UnlitMaterial node. It is only allowed to define a *backMaterial* if the *material* is also defined (not NULL). The node type provided to *backMaterial* (if any) must match the node type provided to *material*. This field allows to render back faces with a different material parameters than the front faces. The meaning and all constraints of this field are explained in the section Two-sided materials.

The *fillProperties* field, if specified, shall contain a FillProperties node. If *fillProperties* is NULL or unspecified, the *fillProperties* field has no effect.

The *lineProperties* field, if specified, shall contain a LineProperties node. If *lineProperties* is NULL or unspecified, the *lineProperties* field has no effect.