SPEOS를 이용한 Prism Backlight unit Design & Simulation

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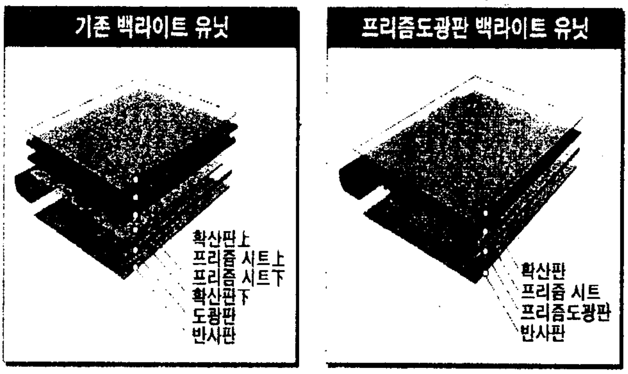
INDEX

1. 프리즘 도광판의 구성

프리즘도광판 비교도

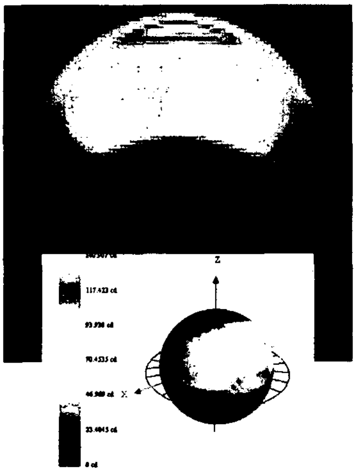


기존 노트북용 LCD패널의 밝기는 보통 150칸델라에서 200칸델라에 그치고 있는 반면 이 기술을 적용한 프리즘 도광판의 15인치 LCD패널은 모니터와 비슷한 300칸델라까지 지원, 동영상이나 게임을 더욱 밝은 화면에서 실감나게 즐길 수 있게 된다.

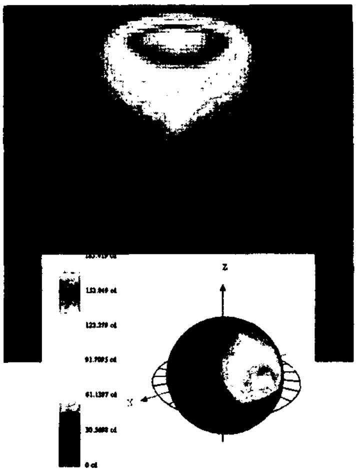
프리즘 도광판 제조기술은 노트북 PC용 백라이트 유닛의 핵심 부품으로 램프에서 나오는 빛을 균일하게 분산시켜 화면에 전달하는 역할을 하는 도광판에 프리즘 가공을 한 것으로 같은 램프를 사용하고도 화면 밝기를 40%정도 향상시켰다.

또 전량 수입에 의존하던 고가의 프리즘 시트를 2매에서 1매로 줄임으로써 연 200억원의 수입대체 효과와 30%의 생산성 향상을 기대할 수 있게 됐다.

Horizontal / Vertical 프리즘 가공 시야각 비교



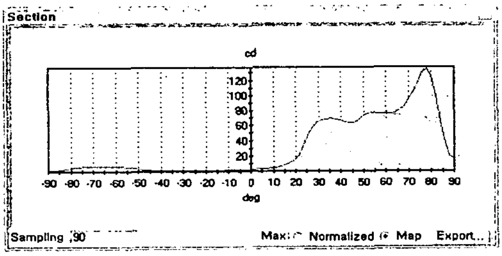
Source 와 평행



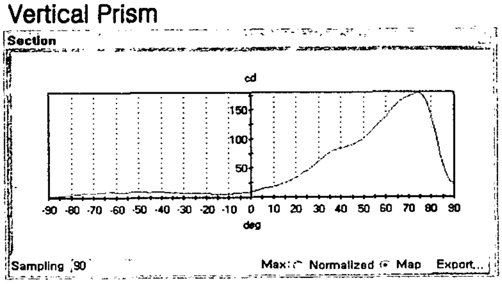
Source 와 수직

Horizontal / Vertical 프리즘 가공 시야각 비교 (Vertical graph)

Horizontal Prism

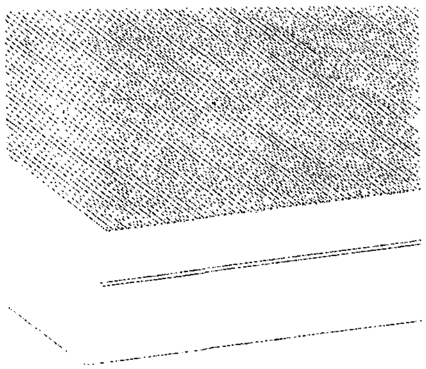


Vertical Prism



2. Wedge Light guide Modeling (15.4 inch)

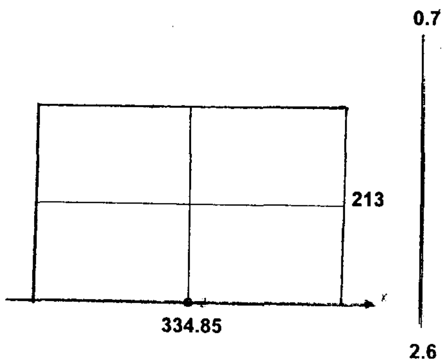
- LGP size 334.85 x 213 (입광부 2.6/ 대광부 0.7)
- SPEOS Coding (Light guide, Reflector sheet...)
  - CURVE2D_POLYLINE
  - VOLUME_EXTRUSION
  - ROTATION (Rotate_angle = atn((2.6 - 0.7) / 213)*180/3.141592...)



3. Prism Modeling (OSB/CSG Texture 이용)

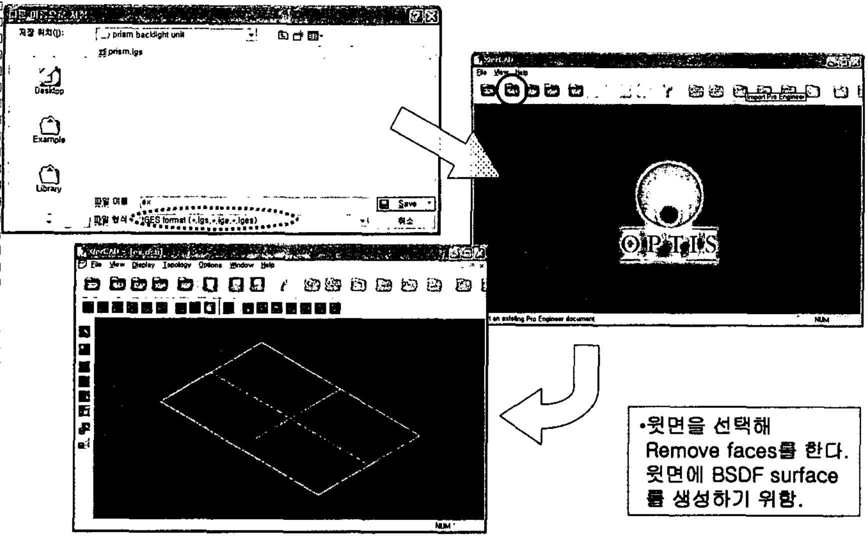
Help → Contents → polyline_2D

```
DECLARE CURVE2D_POLYLINE LGP단면
BEGIN LGP단면
  vertices = DATA
  0 0
  0 2.6
  213 2.6
  213 1.5
  END_DATA
  close = ON
END

DECLARE VOLUME_EXTRUSION LGP1
BEGIN LGP1
  position = -167.425 0 -1.3
  Vector_I = 0 1 0
  Vector_J = 0 0 1
  generatrix = LGP단면
  length = 334.85
  Surface = OPTICAL_POLISHED
  Material = BASIC_MATERIAL PMMA 1.49 1.7e-3 57.2
  Color = 3
END
```



3-1. OSB Object인 경우

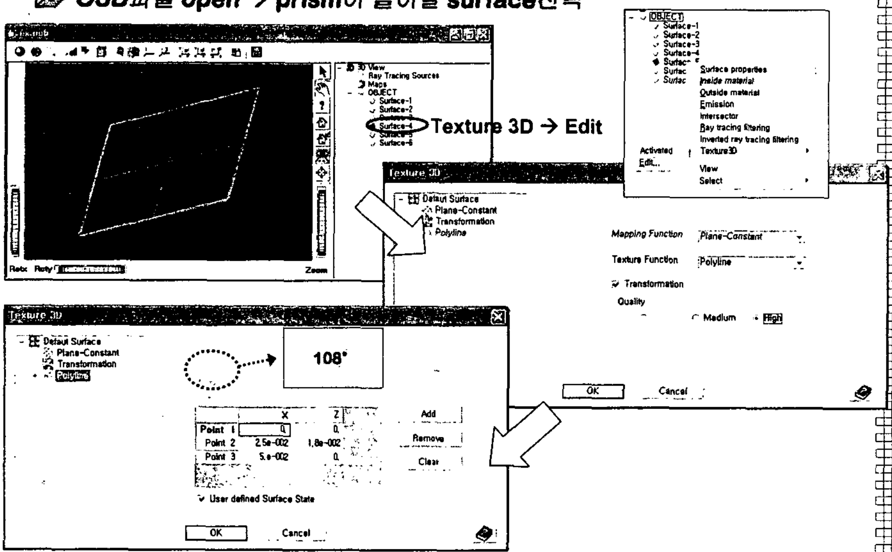
◈ **File → Export → iges(step) →XferCAD →OSB파일생성**



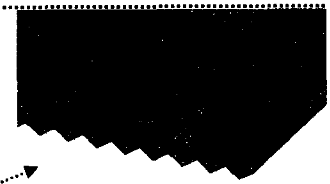
•윗면을 선택해 Remove faces를 한다. 윗면에 BSDF surface를 생성하기 위함.

3-1. OSB Object인 경우

OSB파일 open → prism이 들어갈 surface선택



3-2. CSG Object인 경우



```
DECLARE 3DTEXTURE T001
BEGIN T001
  Position      = 0 0 0
  Vector_I      = 1 0 0
  Vector_J      = 0 1 0
  Surface       = PERFECT_MIRROR 100.0
  Material      = BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
  Color         = 7
  FILENAME      = prism.txt
END
```

EXTRUDED_CLOSED_POLYGON → 생성 할 모델명 (꼭 대문자로 적어야 한다!!)
1 → txt 갯 수
0 0 0 1 0 0 0 0 1 50 3 0 0 0.05 0 0.025 −0.018
(Position X / Position Y / Position Z // Vertor Ix / Vertor Iy / Vertor Iz // Vertor Jx / Vertor Jy / Vertor Jz // Length // Number Vertexes // Vertex 1X / Vertex 1Y // Vertex 2X / Vertex 2Y // Vertex 3X / Vertex 3Y // Vertex 4X / Vertex 4Y)

3-2. CSG Object인 경우

1. SPHERE
Position X / Position Y / Position Z // Radius
(ex : 0 0 0 / 0.5) 

2. CYLINDRE
Position X / Position Y / Position Z // Axis X / Axis Y / Axis Z // Radius / Length
(ex : 0 0 0 / 0 1 0 / 0.5 / 10) 

3.ELLIPTICAL CYLINDER
PositionX / PositionY / PositionZ // VectorI_X / VectorI_Y / VectorI_Z // VectorJ_X/ VectorJ_Y / VectorJ_Z // DimensionX /DimensionY / Length 

4. BOX
Position X / Position Y / Position Z // Vertor Ix / Vertor Iy / Vertor Iz // Vertor Jx / Vertor Jy / Vertor Jz // Dimension X /Dimension Y/ DimensionZ
(ex : 0 0 0 / 1 0 0 / 0 1 0 / 1 1 1) 

5. CONE
Position X / Position Y / Position Z // Axis X / Axis Y / Axis Z // Radius // Length // Angle
(ex : 0 0 0 / 0 1 0 / 0.5 / 10 / 45) 

3-2. CSG Object인 경우

6. ELLIPSOID
Position X / Position Y / Position Z // Vertor Ix / Vertor Iy / Vertor Iz // Vertor Jx / Vertor Jy / Vertor Jz // Dimension X / Dimension Y/ DimensionZ
(ex : 0 0 0 / 1 0 0 / 0 1 0 / 0.1 0.1 0.03)

7. LENS
Position X / Position Y / Position Z // Axis X / Axis Y / Axis Z // Radius1 / Conic1 // Radius2 / Conic2 //Thickness // Aperture
(ex : 0 0 0 / 0 1 0 / 100 0 / -100 0 / 10 / 50)

8. EXTRUDED_CLOSED_POLYGON
Position X / Position Y / Position Z // Vertor Ix / Vertor Iy / Vertor Iz // Vertor Jx / Vertor Jy / Vertor Jz // Length // Number Vertexes// Vertex 1X /Vertex 1Y // Vertex 2X / Vertex 2Y // Vertex 3X / Vertex 3Y // Vertex 4X / Vertex 4Y)
(ex : 0 0 0 /1 0 0 / 0 1 0 / 20 / 4 / 1 0 / -1 0 / -6 -5 / 6 -5)

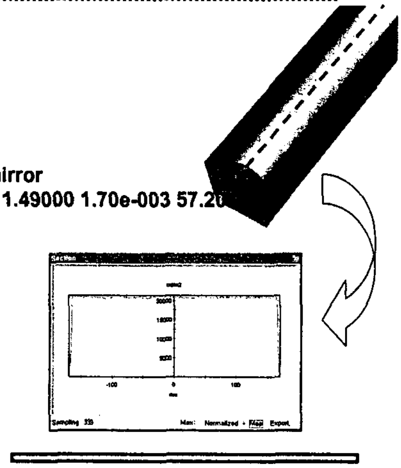
9. POLYHEDRON
Position X / Position Y / Position Z // Vertor Ix / Vertor Iy / Vertor Iz // Vertor Jx / Vertor Jy / Vertor Jz // Number Vertexes // Vertex1X / Vertex 1Y/ Vertex 1Z // Vertex 2X / Vertex 2Y / Vertex 2Z // Vertex 3X / Vertex 3Y / Vertex 3Z // Vertex 4X / Vertex 4Y /Vertex4Z.. // Number face //Face1Number Vertexes // Face1 IndexVertex1 / Face1 IndexVertex2 // Face2Number Vertexes //Face2 IndexVertex1 / Face2 IndexVertex2 //Face3Number Vertexes // Face3 IndexVertex1 / Face3 IndexVertex2 ...)
(ex : 0 0 0 / 1 0 0 / 0 1 0 / 5 / 0 0 0 / 1 0 0 / 1 1 0 / 0 1 0 / 0.5 0.5 1 / 5 / 3 / 1 2 5 / 3 / 2 3 5 / 3 / 3 4 5 / 3 / 4 1 5 / 4 / 1 2 3 4)

3-2. CSG Object인 경우

```
DECLARE ROTATION rot
BEGIN rot
  position              = 0 0 0
  vector_axis           = 1 0 0  ; Direction of the axis
  angle                 = Rotate_angle ; Rotation angle (in degrees)
END

DECLARE 3DTEXTURE T001
BEGIN T001
  Position              = 0 0 0
  Vector_I              = 1 0 0
  Vector_J              = 0 1 0
  Surface               = OPTICAL_POLISHED
  Material              = BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
  Color                 = 255 100 255
  FILENAME = prism2.txt
END
TRANSFORM T001          = rot T001

DECLARE SYSTEM System001
BEGIN System001
  Position              = 0 0 0
  Vector_I              = 1 0 0
  Vector_J              = 0 1 0
  Geometry  = LGP + T001
END
```

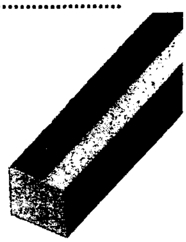
Boolean Operation

4. Source Modeling



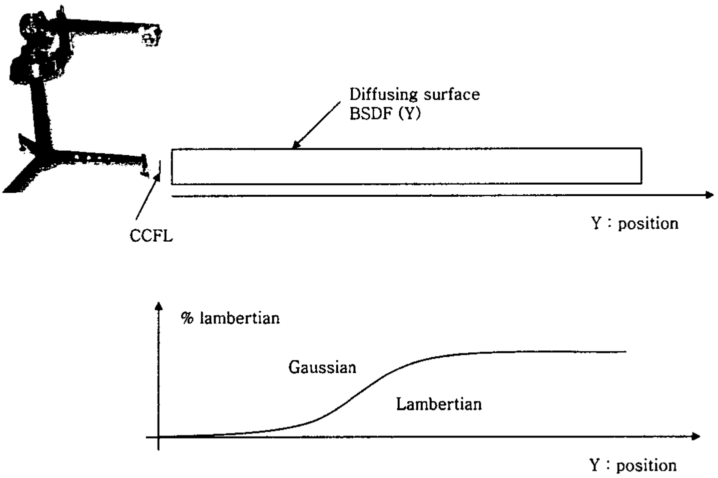
```
DECLARE CYLINDER CCFL
BEGIN CCFL
  Position        = 0 0 0
  Vector_axis     = 1 0 0
  Radius          = 1
  Length          = 330
  Surface         = ROUGH_MIRROR CCFL.mirror
  Material        = BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
  Color           = 255 255 255
END

DECLARE SOURCE Source001
BEGIN Source001
  Geometry        = CCFL
  Emission        = LAMBERT
  Power           = 200
  Unit            = lumen
  Spectrum        = filename White.spectrum
  Angle           = 90
END
```

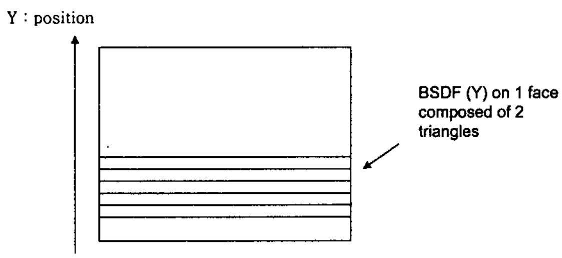
Source reflector



```
DECLARE PARALLELEPIPED ccfl_reflector_1
BEGIN ccfl_reflector_1
  Position        = 0 0 0
  Vector_I        = 1 0 0
  Vector_J        = 0 1 0
  DimensionX      = 334.95
  DimensionY      = 2.65
  DimensionZ      = 2.7
  Surface         = OPTICAL_POLISHED
  Material        = BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
  Color           = 100 255 100
END

DECLARE PARALLELEPIPED ccfl_reflector_2
BEGIN ccfl_reflector_2
  Position        = 0 0.05 0
  Vector_I        = 1 0 0
  Vector_J        = 0 1 0
  DimensionX      = 334.85
  DimensionY      = 2.6
  DimensionZ      = 2.6
  Surface   = SIMPLE_SCATTERING_REFLECTION_ONLY 3.000000 10.000000 90.000000 2.000000
  Material  = BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
  Color     = 100 255 100
END

DECLARE SYSTEM System001
BEGIN System001
  Position        = 0 0 0
  Vector_I        = 1 0 0
  Vector_J        = 0 1 0
  Geometry        = CCFL_REFLECTOR_1 - CCFLI_REFLECTOR_2
END
```

5. BSDF user surface Modeling (Send Blast)





산란면을 쪼개어 각각의 면에 산란특성을 측정된 산란율
혹은 사용자가 정의한 분포 곡선대로 Data를 입력한다.

Surface Data

Progressive.txt - Bloc-notes

Fichier Edition Format Affichage ?

```
SPEOSCADFILE#1.0
SECTION INFORMATIONS
END_SECTION
SECTION GEOMETRY
1000
2
0 0 0
0 0.2 0
100 0 0
0 0 1
0 0 1
0 0 1
```

Progressive.txt - Bloc-notes

Fichier Edition Format Affichage ?

```
100 200 0
100 199.8 0
0 0 1
0 0 1
0 0 1
END_SECTION
SECTION PROPERTIES
Surface=1
SIMPLE_SCATTERING_TRANSMISSION_ONLY 0 6.2 93.8 25
BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
BASIC_MATERIAL AIR 1.00000 0.00e+000
Surface=2
SIMPLE_SCATTERING_TRANSMISSION_ONLY 0 6.2 93.8 25
BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
BASIC_MATERIAL AIR 1.00000 0.00e+000
Surface=3
SIMPLE_SCATTERING_TRANSMISSION_ONLY 0 6.3 93.7 25
BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
BASIC_MATERIAL AIR 1.00000 0.00e+000
```

Ln 6, Col 2

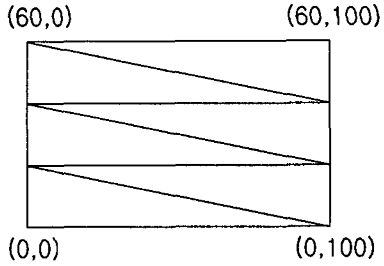
C Language source sample

isotrc | Win32 Release

```
        dP4Z     = 0.0;
        // First facet : 3 vertex then 3 normals
        ofsOut << dP1X << " " << dP1Y << " " << dP1Z << endl;
        ofsOut << dP2X << " " << dP2Y << " " << dP2Z << endl;
        ofsOut << dP4X << " " << dP4Y << " " << dP4Z << endl;
        ofsOut << 0.0  << " " << 0.0  << " " << 1.0  << endl;
        ofsOut << 0.0  << " " << 0.0  << " " << 1.0  << endl;
        ofsOut << 0.0  << " " << 0.0  << " " << 1.0  << endl;
        // Second facet : 3 vertex then 3 normals
        ofsOut << dP2X << " " << dP2Y << " " << dP2Z << endl;
        ofsOut << dP3X << " " << dP3Y << " " << dP3Z << endl;
        ofsOut << dP4X << " " << dP4Y << " " << dP4Z << endl;
        ofsOut << 0.0  << " " << 0.0  << " " << 1.0  << endl;
        ofsOut << 0.0  << " " << 0.0  << " " << 1.0  << endl;
        ofsOut << 0.0  << " " << 0.0  << " " << 1.0  << endl;
    }

    ofsOut << "END_SECTION" << endl;

    // optical properties of faces 1 to nY
    ofsOut << "SECTION PROPERTIES" << endl;
    for (iY=0; iY<nY; iY++)
    {
        ofsOut << "Surface=" << iY+1 << endl;
        dLambertian = 100 * exp(-(iY - nY)*(iY - nY) * dHalfGauss
        dLambertian = ((int)(dLambertian * 10.0)) / 10.0;
        ofsOut << "SIMPLE_SCATTERING_TRANSMISSION_ONLY " << 0.0
        ofsOut << "BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20" <
        ofsOut << "BASIC_MATERIAL AIR 1.00000 0.00e+000" << endl;
    }
    ofsOut << "END_SECTION" << endl;

    ofsOut.close();

    return 0;
}
```

BSDF Surface Sample file (*.txt)

```
SPEOSCADFILE#1.0
SECTION INFORMATIONS
END_SECTION
SECTION GEOMETRY
3
2
0 0 0
0 20 0
100 0 0
0 0 1
0 0 1
0 0 1
0 20 0
100 20 0
100 0 0
0 0 1
0 0 1
0 0 1
2
0 20 0
0 40 0
100 20 0
0 0 1
0 0 1
0 0 1
...
...
END_SECTION
```




```
SECTION PROPERTIES
Surface=1
SIMPLE_SCATTERING_TRANSMISSION_ONLY 0 0.03 99.97 15
BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
BASIC_MATERIAL AIR 1.00000 0.00e+000
Surface=2
SIMPLE_SCATTERING_TRANSMISSION_ONLY 0 0.04 99.96 15
BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
BASIC_MATERIAL AIR 1.00000 0.00e+000
Surface=3
SIMPLE_SCATTERING_TRANSMISSION_ONLY 0 0.04 99.96 15
BASIC_MATERIAL PMMA 1.49000 1.70e-003 57.20
BASIC_MATERIAL AIR 1.00000 0.00e+000
END_SECTION
```

OptisWork Object 를 이용하여 BSDF Surface file (*.txt)을 불러와 기존 OSB Object와 결합 합니다. 이때 Surface가 위치 할 면은 사전에 제거 되어 있어야 합니다.

6. 역 프리즘 sheet의 특성 분석

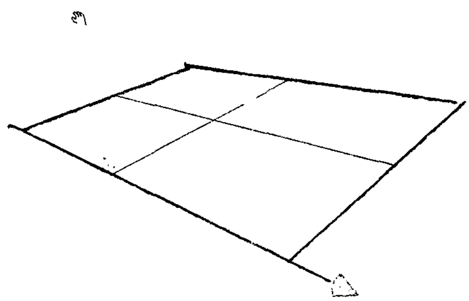
	63/57/230	65/57/230	68/57/230	70/50/160
0	0.811177	0 816785	0.83372	0 83996
10				
20				
30				
40				
50	0 94939	0 937245	0.889023	0 86605
60	0 989874	0 984181	0.957288	0.943062
70	0 999505	0.999992	0.993029	0.986733
80	0 979646	0 986271	0.998725	0.999986

	63			
0	35 78891	35 23576	33.51721	32.8641
10				
20				
30				
40				
50	18 30647	20.40608	27 24927	29.99718
60	8.160631	10 20473	16 80624	19 42769
70	1.802844	0 229183	6 769207	9.343408
80	11 57982	9 505068	2.893603	0 303181

SPEOS에서 Box Object를 이용하여 Geometry를 만든 후 IGES 혹은 STEP file로 Export 합니다.

XferCAD를 이용하여 OSB file을 만들고 프리즘 면을 선택하여 Texture Mapping 합니다.

3D View에서 입사각을 조정하여 출사되는 각을 측정합니다.



7. Prism 각도 별 시야각 분석

Pitch – 50 ㎛

101°
높이 – 20.59 ㎛

102°
높이 – 20.23 ㎛

103°
높이 - 19.87 ㎛

104°
높이 – 19.52 ㎛

105°
높이 – 19.17 ㎛

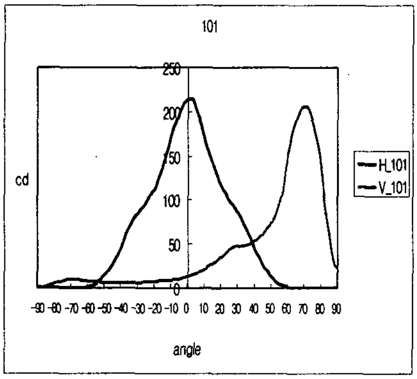
106°
높이 – 18.82 ㎛

107°
높이 – 18.48 ㎛

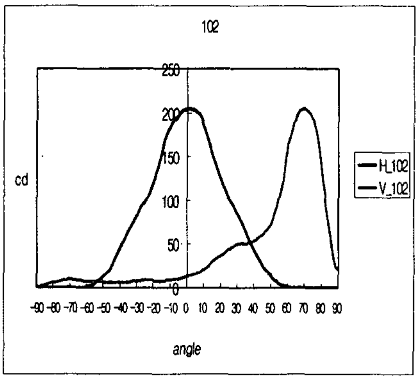
108°
높이 – 18.15 ㎛

109°
높이 – 17.82 ㎛

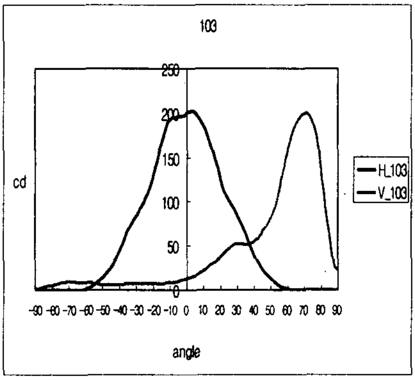
110°
높이 – 17.49 ㎛

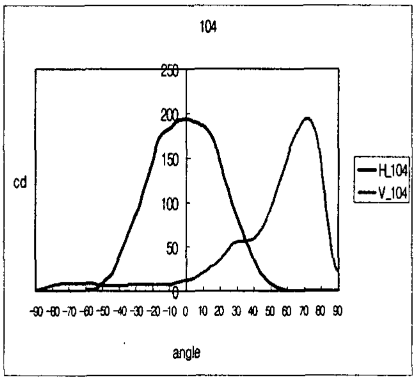


Max Vertical angle – 69.78



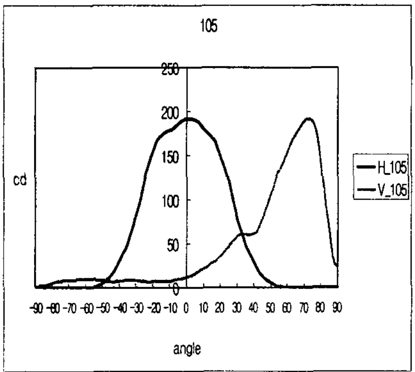
Max Vertical angle – 69.78

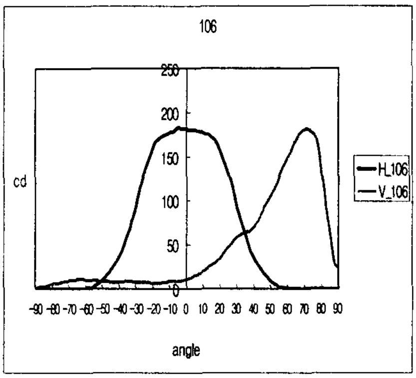




Max Vertical angle – 69.78

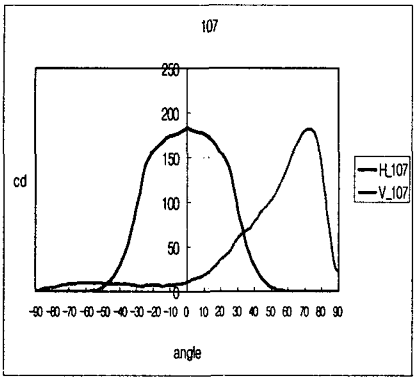
Max Vertical angle – 71.8

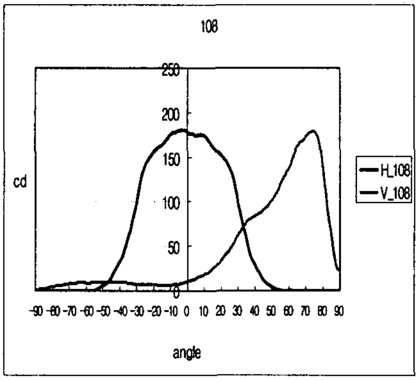




Max Vertical angle – 73.82

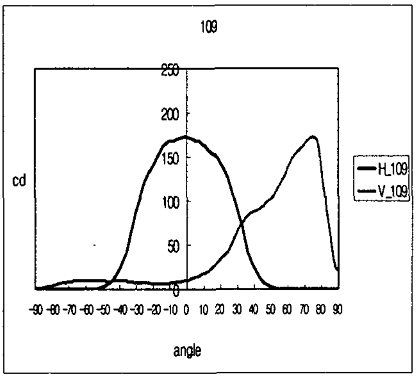
Max Vertical angle – 71.8

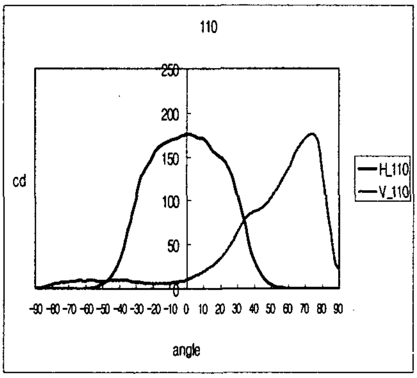




Max Vertical angle – 73.82

Max Vertical angle – 73.82



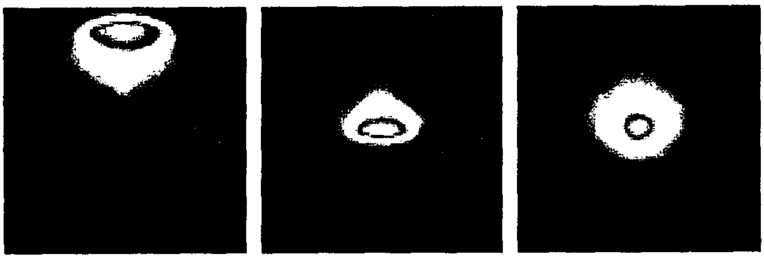


Max Vertical angle – 75.84

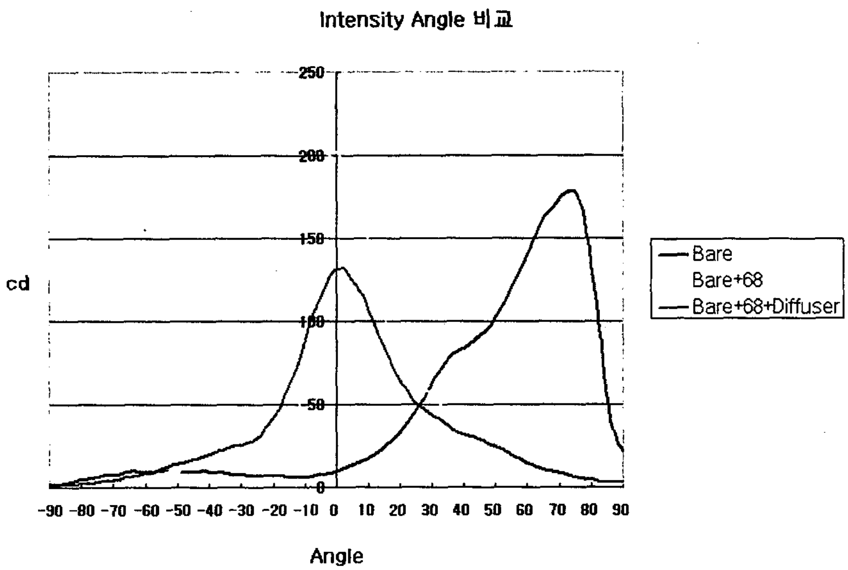
Max Vertical angle – 73.82

8. Complete Model 결과 분석

- Prism angle 108°
- Prism angle 108° + Reverse prism sheet 68°
- Prism angle 108° + Reverse prism sheet 68° + Diffuser sheet



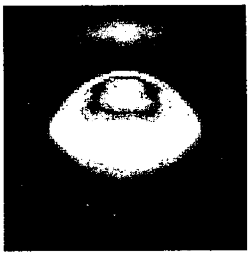
시야각 비교 (수직 0°)



일반 Prism 도광판과의 비교

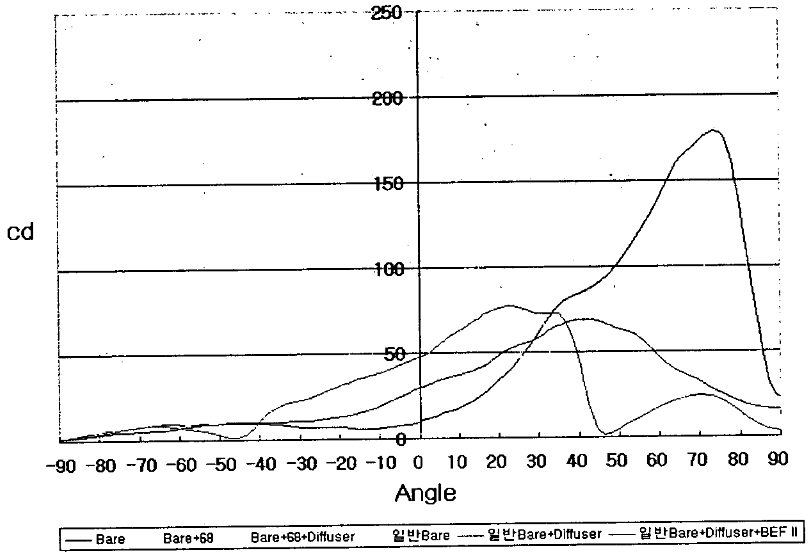
Bare

Bare+Diffuser

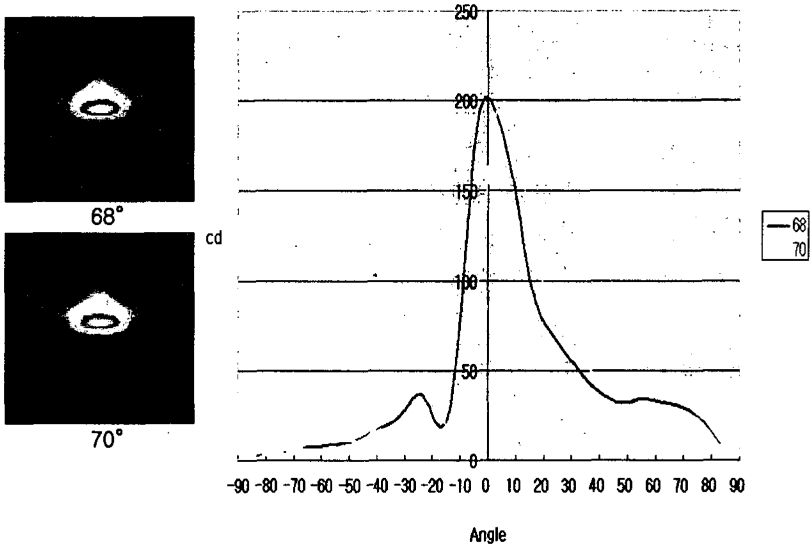


Bare+Diffuser+BEF II

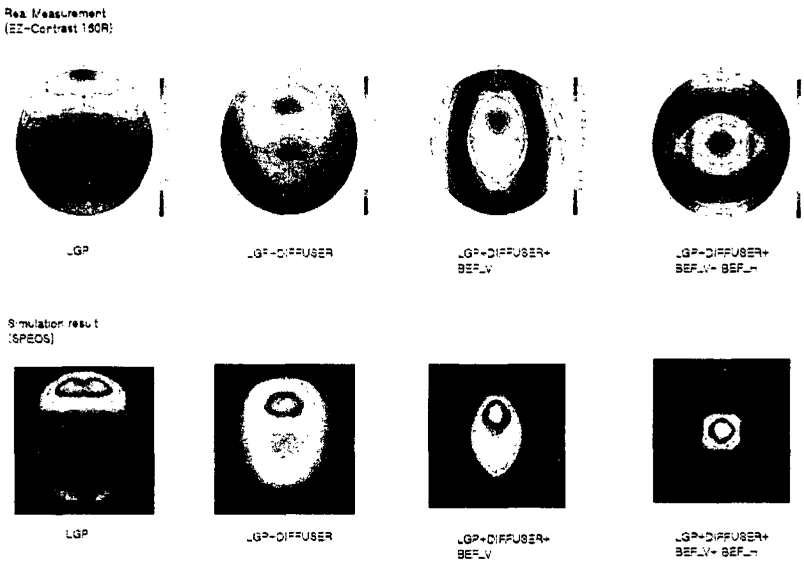
시야각 비교 (수직 0°)



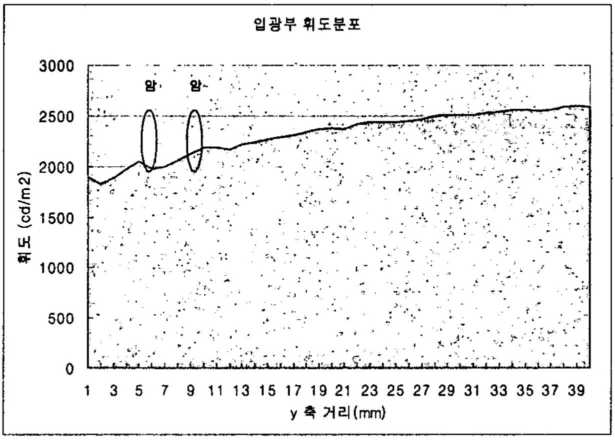
Reverse prism sheet 68°/70° 비교



Sheet 별 측정 및 Simulation 비교

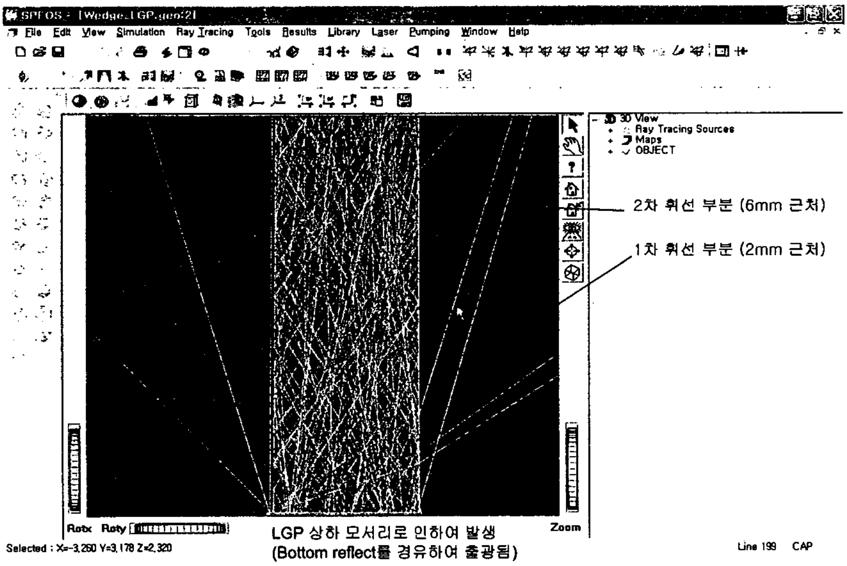


9. 설계 시 문제점 및 해결 방안

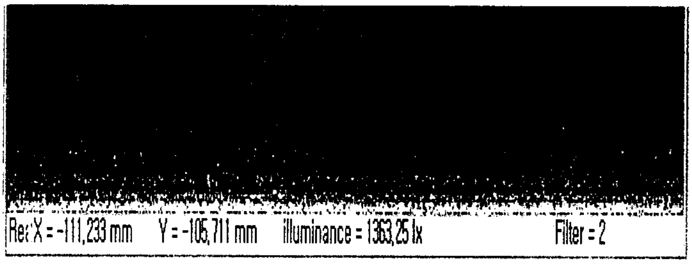


CCFL source 입광부 암부 발생 분석

Ray Trace



Result of simulation



입광부 상에 나타난 휘선과 암선

차광 Tape 처리 후