



CITY OF HOUSTON HOUSTON AIRPORT SYSTEM

WILLIAM P. HOBBY
AIRPORT

SURVEYORS
HANDBOOK

September 2006

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civil engineering • land surveying

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WILLIAM P. HOBBY AIRPORT SURVEYORS HANDBOOK

City of Houston, Texas
Houston Airport System

FOREWORD

This handbook has been designed to provide information to land surveyors, engineers, and others who use survey control in conjunction with the planning, designing, and constructing of facilities and improvements to the City-owned Hobby Airport (HOU) in southeast Houston. The handbook discusses recent control surveys, their basis and relationships to other control systems, and their recommended uses. It includes a network map showing the approximate locations of all airport Primary Control Monuments and individual location sketches with coordinates and elevations for each monument. Any project which requires the use of survey control should refer to this document for recommendations and information regarding this control.

BACKGROUND

Hobby Airport is the City of Houston's oldest airport. As the airport has developed, projects have been referenced to available City of Houston (COH) or National Geodetic Survey (NGS) benchmarks. Until the mid-1980s these benchmarks were referenced horizontally to the North American Datum of 1927 and vertically to the National Geodetic Vertical Datum of 1929. These two reference datums were replaced in the 1980's by the North American Datum of 1983 and the North American Vertical Datum of 1988. Since that time new technologies and applications which work in the newer reference datum, such as GIS and GPS, have revolutionized navigation, airport planning, and other related fields.

This handbook provides the results of control surveying performed at HOU in order to create a new network of benchmarks for use on all future improvement projects. Surveying was performed in 2006 within the Airport Operations Area (AOA) to establish control which can be used with conventional surveying equipment as well as GPS in support of future improvement projects. The network of control points thus created is referred to as the HOU Primary Control Network. Additional points which were used for recent aerial photography control were also surveyed in order to provide a secondary set of control and establish the relationship between the new control and the aerial orthophotography.

SURVEY OF HOU PRIMARY CONTROL NETWORK

The horizontal and vertical control survey was performed by Landtech Consultants, Inc. during July and August, 2006 for the purpose of establishing the new HOU Primary Control Network. Four new control points were constructed and surveyed. They were located so as to function as two intervisible pairs, and were constructed so as to have good stability and survivability over time. Newly surveyed horizontal positions, referenced to the newest available datum, were established for these four and a fifth existing NGS benchmark (NGS Tristation "HOBBY") using static GPS procedures. The static GPS survey tied these five on-site monuments to three existing nearby Harris County Floodplain Reference Marks (also known as TSARP benchmarks) and three NGS GPS Continuously Operating Reference Stations (CORS).

The minimally constrained adjustment showed that the CORS stations and "HOBBY" agreed horizontally to within 0.03' but there were substantial differences in the vertical. The Floodplain Reference Marks agreed with each other vertically within 0.02'.

The following points were held as fixed horizontal control in the final adjustment of the static GPS survey:

NORTHEAST 2250 CORS ARP ("NETP")
HOUSTON 2 COOP CORS ARP ("COH2")
HOUSTON 3 COOP CORS ARP ("COH3")
NGS TRISTATION "HOBBY"

The final horizontal adjustment meets relative positioning accuracy standards for NGS B Order GPS surveys as defined by the Federal Geodetic Control Committee in *Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques* dated August 1, 1989.

Differential leveling was performed using a digital / barcode leveling system to establish newly surveyed elevations for these points. As previously stated, the static GPS survey showed that three Harris County Floodplain Reference Marks (Nos. 030280, 030300, and 010545) agreed with each other to within 0.02'. Differential level loops were run from RM 030300, which was the closest to the airport, to all of the on-site primary and secondary control points. All level loop raw closures met the closure specification for a Second Order Class II survey.

Coordinate and elevation listings and recovery sketches for each primary and secondary point are provided in the table "Final Coordinates and Elevations – Primary and Secondary Control Network"

SURVEY OF HOU SECONDARY CONTROL

A sampling of the points which were used as aerial photography control in 2002 was surveyed using GPS Real-Time Kinematic (RTK) procedures to tie the points to the primary control. Eleven points were selected as a representative sample of points evenly distributed around the perimeter of the airport property. Differential leveling was also performed using a digital / barcode leveling system to establish newly surveyed elevations for these points.

Comparisons of new coordinates and elevations to the values used for the aerial control are provided in the table "Aerial Control Points – Comparison of Call to Found". Differences between the latest survey and the 2002 survey are to be expected for several reasons. First, although the horizontal datum referenced in each survey is the same, different reference monuments were held for control. Secondly, different procedures were used for both horizontal and vertical control surveying. In the case of the elevations, a different vertical adjustment of NAVD 88 was held in each survey.

The comparisons show fairly small shifts in the horizontal components and substantially larger shifts in the vertical. The average 2-d horizontal shift is 0.12' in a mostly north direction. The average vertical shift is 0.28' down from previous values. When the 2002 aerial photos are used in conjunction with the new HOU primary or secondary control, one can expect to see differences of this general magnitude.

NAMING OF MONUMENTS AND RECOVERY SKETCH FORMAT

The numeric system of naming the monuments is the standard system currently in use by the City of Houston. City Surveyor Robert Towery, RPLS, was consulted in this regard and provided the method of naming as well as the standard City of Houston monument recovery sketch template which was used on the recovery sketches included herein. The first four digits of the monument name refer to the City's map sheet number which the monument plots on. The second group of four digits refers to the position on the sheet which the monument plots on, based on a 16 x 16 Interior grid. For further information refer to the City of Houston Department of Public Works publication *Comprehensive Survey Monumentation and Mapping Program User's Manual*. Per Mr. Towery's instructions, currently all new monuments are using a revised numbering structure wherein the numbering of the east-west interior grid has been modified from the original, which ranged from 1 to 16, to a new range of 71 to 86.

USE OF SURVEY DATA

Horizontal and vertical positions for all primary and secondary control points are provided in tables and recovery sheets. Positions are stated in several different systems for different uses. For horizontal positions, the geodetic NAD83 (CORS) positions are provided (Latitudes and Longitudes). Grid coordinates, expressed as Y and X values and referenced to the Texas Coordinate System of 1983, South Central Zone, are also provided and are correlated to the geodetic positions. The grid coordinates have also been scaled up to surface coordinate values using the project scale factor of 0.999870017 and the formulae:

$$Y_{\text{Grid}} / 0.999870017 = Y_{\text{Surface}}; \quad X_{\text{Grid}} / 0.999870017 = X_{\text{Surface}}$$

The scale factor used for this project is the same as that used for the 2002 aerial photography in order to make the new control compatible.

It is recommended that, for all new design and construction related uses, surveys and maps should be prepared using the surface coordinates as provided. This will result in a uniform scaling of coordinates for all projects and make possible an easy integration of separate project surveys and maps into a single system such as a GIS.

DATUM STATEMENT

The following datum statement is a summary of the above discussion and will apply to the use of all survey data provided herein:

All coordinates are referenced to NAD 83(CORS). Horizontal control surveys were performed using GPS. The published values for NGS Station "HOBBY" and CORS Stations "COH2", "COH3", and "NETP" (Epoch Dates 2002.00) were held for horizontal control in the final network adjustment. All elevations are referenced to NAVD88 (2001 Adjustment). Vertical control surveys were performed using differential leveling. The published value for TSARP Monument "030300" was held as fixed in the final network adjustment. Geoid heights were determined using GEOID03. The unit of measure for this project is the U. S. Survey Foot.

**FINAL COORDINATES AND ELEVATIONS
PRIMARY AND SECONDARY CONTROL NETWORK**
* - Held in final adjustment

POINT NAME	NAD 83(1983) GRID		NAD 83(1983) SURFACE (CSF=0.999870017)		NAD 83(1983) GEOGRAPHIC		NAVD 88 (2001 adj.)	Also Known As
	Northing (Y)	Easting (X)	Northing (Y)	Easting (X)	Latitude	Longitude		
5653-7907	13805390.888	3153787.877	13807185.567	3154197.869	29°39'25.667082°N	95°16'02.444169°W	33.78	1
5652-7208	13797403.115	3147696.816	13799196.776	3148106.016	29°38'08.545013°N	95°17'14.325564°W	42.39	4
5652-7508	13797480.347	3150442.768	13799274.018	3150852.325	29°38'08.445359°N	95°16'43.194550°W	40.74	5
5653-7807	13805155.848	3152960.977	13806950.517	3153370.862	29°39'23.602654°N	95°16'11.897286°W	36.88	6
125	13804673.886	3147340.582	13806468.492	3147749.736	29°39'20.603671°N	95°17'15.745571°W	39.14	aerial ctrl. pt.
126	13804259.686	3149414.943	13806054.238	3149824.367	29°39'15.852693°N	95°16'52.394096°W	41.92	aerial ctrl. pt.
127	13804676.860	3152254.242	13806471.466	3152664.035	29°39'18.085988°N	95°16'20.077068°W	38.34	aerial ctrl. pt.
128	13803975.899	3153787.242	13805770.414	3154197.234	29°39'11.665799°N	95°16'02.963156°W	35.64	aerial ctrl. pt.
133	13802676.734	3147867.180	13804471.080	3148276.403	29°39'00.675728°N	95°17'10.498382°W	41.88	aerial ctrl. pt.
144	13800867.986	3144042.603	13802662.098	3154452.628	29°38'40.831476°N	95°16'01.194446°W	35.27	aerial ctrl. pt.
148	13799194.791	3147243.771	13800968.685	3147652.912	29°38'05.498217°N	95°17'18.812929°W	44.45	aerial ctrl. pt.
155	13797051.549	3148219.138	13798845.164	3148628.406	29°38'04.901975°N	95°17'08.535767°W	42.57	aerial ctrl. pt.
156	13797173.443	3150157.694	13798987.074	3150567.214	29°38'05.488217°N	95°16'46.534180°W	43.19	aerial ctrl. pt.
157	13797499.990	3151901.707	13799293.684	3152311.454	29°38'08.179924°N	95°15'59.723803°W	38.18	aerial ctrl. pt.
158	13797808.867	3154270.117	13799602.600	3154680.171	29°38'08.179924°N	95°15'46.593424°W	30.52	aerial ctrl. pt.
030280	13806880.195	3155139.358	13808675.088	3155549.526	29°38'03.485640°N	95°15'45.243458°W	41.10	(CORS)
030300	13797142.684	3155569.807	13798836.311	3156980.031	29°37'42.693000°N	95°17'28.389170°W	42.35	(CORS)
COH2	13793560.960	3108315.430	13795554.122	3108719.511	29°37'12.616187°N	95°16'30.410844°W	40.42	HOBBY
COH3	13800460.328	3155320.539	13802254.384	3156730.730	29°37'12.616187°N	95°16'30.410844°W	40.42	HOBBY
010545	13791717.414	3148635.572	13793610.335	3147044.634	29°37'12.616187°N	95°16'30.410844°W	40.42	HOBBY
5652-1617	13798754.390	3151530.790	13800548.227	3151940.489	29°38'20.709571°N	95°20'03.165200°W	59.81	(CORS)
NETP	13853429.640	3131034.280	13855230.584	3131441.314	29°47'28.142917°N	95°20'03.165200°W	59.81	(CORS)

ALEX

CH. 11

213-417-9700

713-417-5710 → OPS 3 AIRSIDE

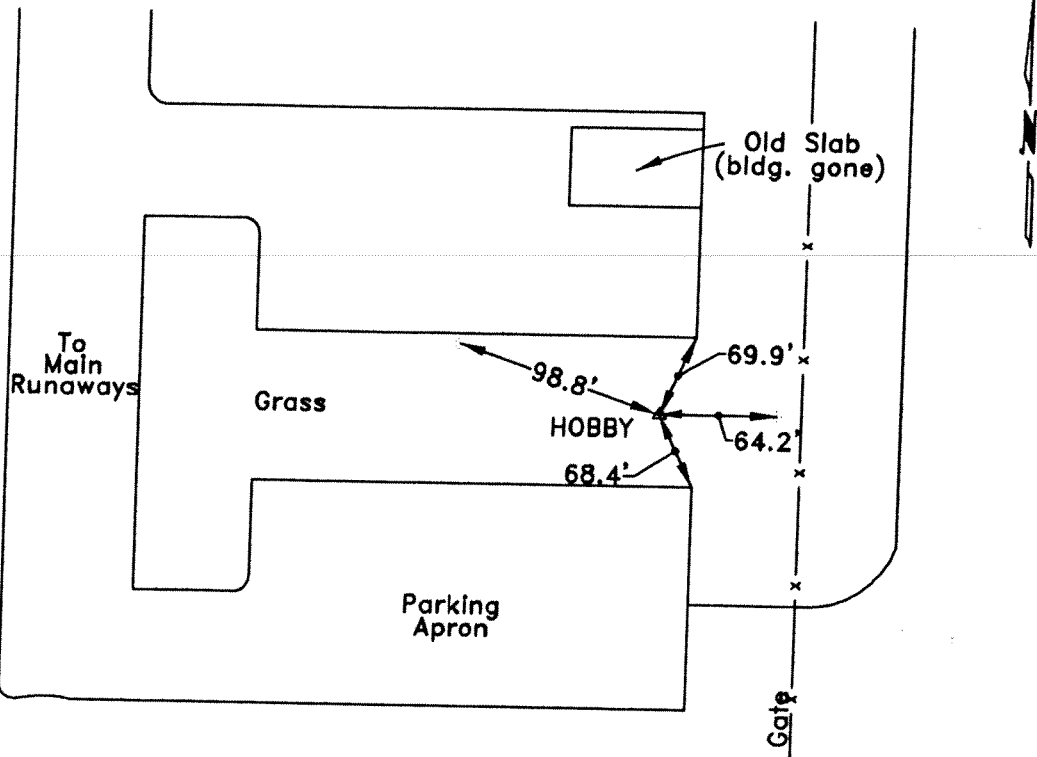


[illegible][illegible]

CITY OF HOUSTON

CITY
SURVEY
MARKER

5652 1617



Texas Coordinate System of 1983, S.C. Zone NAD 88

X= 3151530.790

Y= 13798754.390

Lat.= 29°38'20.709571"N

Lon.= 95°16'30.410844"W

Method For Horizontal GPS

ON MAP SHEET: 5652-A4

Elevations

40.42

Adjustment

2001

Method For Vert. Conventional

Ellipsoid Height= -48.66

(GEOID 03)

Also Known As HOBBY

General Location: 1400 FEET NORTH OF JUNCTION OF BRANIFF AND RANDOLPH STREETS

Date Set: MAY 22, 1974 Type of Mark: NGS DISK IN CONCRETE STAMPED "HOBBY-1968"

NOTE:

1. Scale Factor (S.F. 0.999870017).

2. Surface= $\frac{\text{Grd}}{\text{S.F.}}$

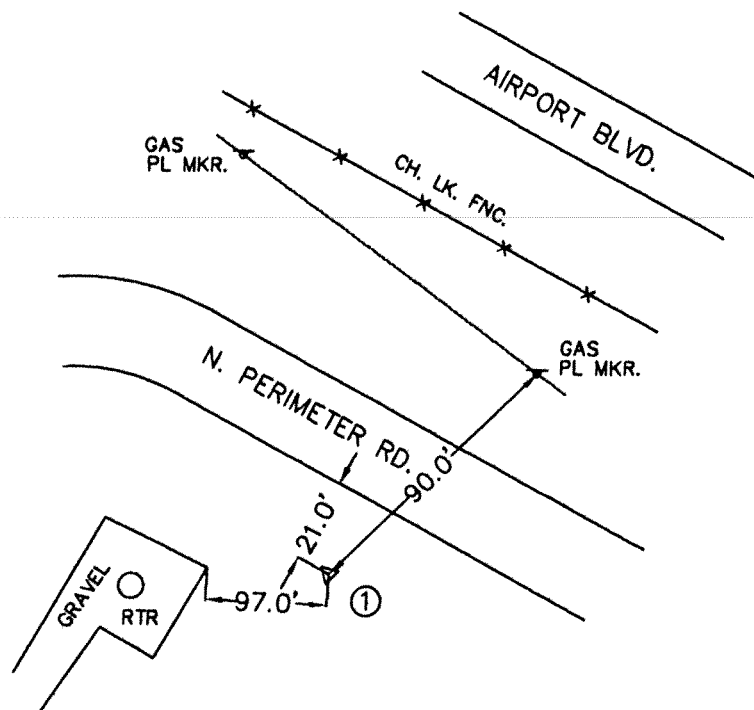
Surveyed By. Landtech Consultants, INC.

2627 North Loop West #224

Houston, TX 77008

Airport Surface Coordinates
 N= 13800548.227
 E= 3151940.489

CITY OF HOUSTON

CITY
SURVEY
MARKER5653
7907

Texas Coordinate System of 1983, S.C. Zone NAD 88

X= 3153787.877

Y= 13805390.868

Lat.= 29°39'25.66708"N

Lon.= 95°16'02.44417" W

Method For Horizontal GPS

ON MAP SHEET: 5653-D1

Elevations

33.78

Adjustment

2001

Method For Vert. CONVENTIONAL

Ellipsoid Height= -55.32

(GEOID 03)

Also Known As

"1"

General Location: N.E. QUADRANT OF HOBBY AIRPORT

Date Set: JULY 12, 2006 Type of Mark: 5/8" ALUMINUM ROD WITH DATUM POINT IN GREASE SLEEVE SET INSIDE A 5" PVC WITH METAL PROTECTIVE COVER.

NOTE:

1. Scale Factor (S.F. 0.999870017).

2. Surface= $\frac{\text{Grid}}{\text{S.F.}}$

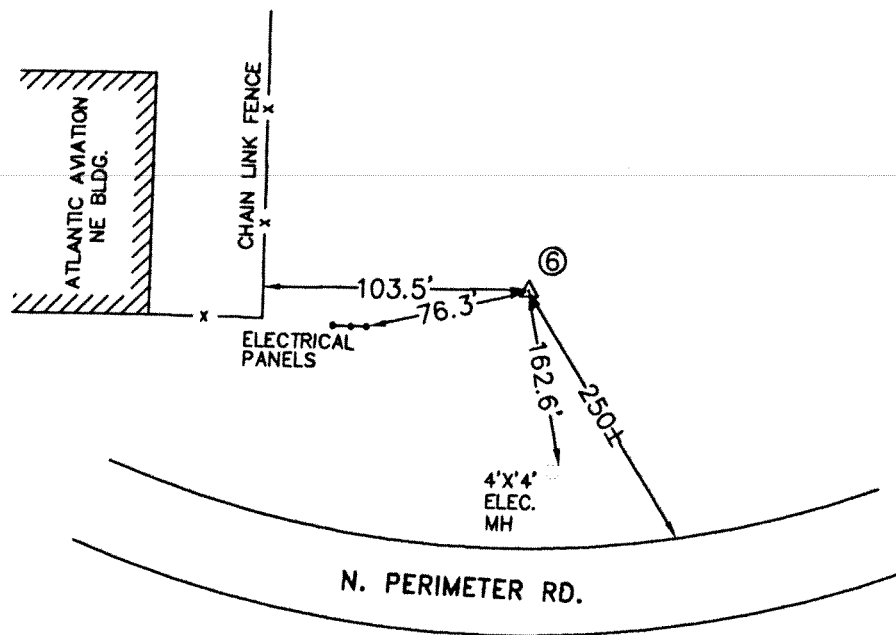
Surveyed By. Landtech Consultants, INC.

2627 North Loop West #224

Houston, TX 77008

Airport Surface Coordinates
N= 13807185.567
E= 3154197.869

CITY OF HOUSTON

CITY
SURVEY
MARKER5653
7807

Texas Coordinate System of 1983, S.C. Zone NAD 88

X= 3152960.977

Y= 13805155.848

Lat.= 29°39'23.60265"N

Lon.= 95°16'11.89729"W

Method For Horizontal GPS

ON MAP SHEET: 5653-C2

Elevations	Adjustment
36.88	2001

Method For Vert. Conventional

Ellipsoid Height= -52.23

(GEOID 03)

Also Known As "6"

General Location: N.E. QUADRANT OF HOBBY AIRPORT

Date Set: JULY 12, 2006 Type of Mark: 5/8" ALUMINUM ROD WITH DATUM POINT IN
GREASE SLEEVE SET INSIDE A 5" PVC WITH METAL PROTECTIVE COVER.

NOTE:

1. Scale Factor (S.F. 0999870017).

2. Surface= $\frac{\text{Grid}}{\text{S.F.}}$

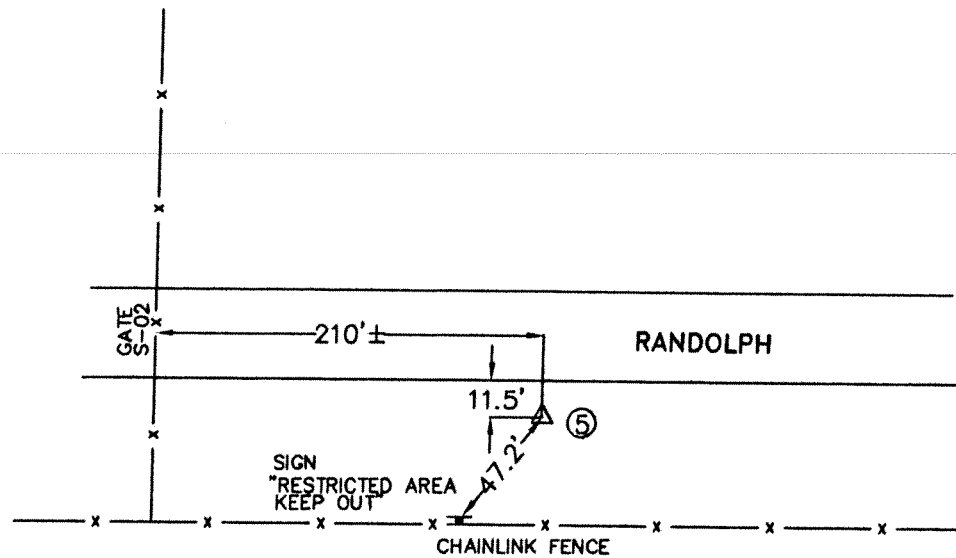
Surveyed By. Landtech Consultants, INC.

2627 North Loop West #224

Houston, TX 77008

Airport Surface Coordinates	
N=	13806950.517
E=	3153370.862

CITY OF HOUSTON

CITY
SURVEY
MARKER5652
7508

Texas Coordinate System of 1983, S.C. Zone NAD 88

X= 3150442.768

Y= 13797480.347

Lat.= 29°38'08.44536"N

Lon.= 95°16'43.19455"W

Method For Horizontal GPS

ON MAP SHEET: 5652-C2

Elevations

Adjustment

40.74

2001

Method For Vert. Conventional

Ellipsoid Height= -48.34

(GEOID 03)

Also Known As

"5"

General Location: S.W. QUADRANT OF HOBBY AIRPORT

Date Set: JULY 12, 2006 Type of Mark: 5/8" ALUMINUM ROD WITH DATUM POINT IN
GREASE SLEEVE SET INSIDE A 5" PVC WITH METAL PROTECTIVE COVER.

NOTE:

1. Scale Factor (S.F. 0.999870017).

2. Surface= $\frac{\text{Grid}}{\text{S.F.}}$

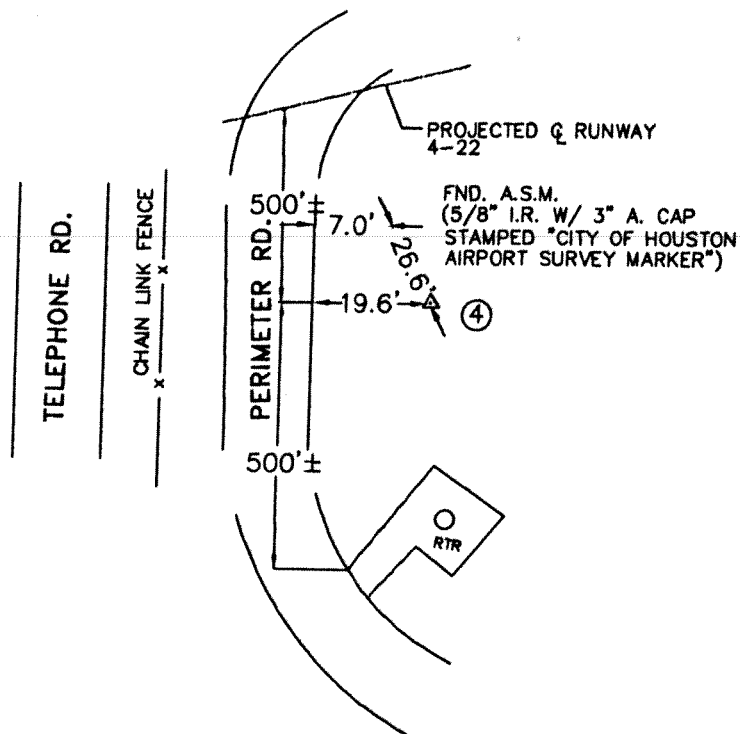
Surveyed By. Landtech Consultants, INC.

2627 North Loop West #224

Houston, TX 77008

Airport Surface Coordinates
N= 13799274.018
E= 3150852.325

CITY OF HOUSTON

CITY
SURVEY
MARKER5652
7208

ON MAP SHEET: 5652-C1

Texas Coordinate System of 1983, S.C. Zone NAD 88

X= 3147696.816

Y= 13797403.115

Elevations Adjustment

~~42.39~~ 42.39 2001

Method For Vert. Conventional

Ellipsoid Height= -46.70

(GEOID 03)

Lat.= 29°38'08.54501"N

Lon.= 95°17'14.32556"W

Method For Horizontal GPS

Also Known As "4"

General Location: S.W. QUADRANT OF HOBBY AIRPORT

Date Set: JULY 12, 2006 Type of Mark: 5/8" ALUMINUM ROD WITH DATUM POINT IN GREASE SLEEVE SET INSIDE A 5" PVC WITH METAL PROTECTIVE COVER.

NOTE:

1. Scale Factor (S.F. 0.999870017).

2. Surface= $\frac{\text{Grid}}{\text{S.F.}}$

Surveyed By: Landtech Consultants, INC.

2627 North Loop West #224

Houston, TX 77008

Airport Surface Coordinates

N= 13799196.776

E= 3148106.016