Complete Drawing Prototypes
For Urban Complete Streets

by

James Ira Winder

Submitted to the Department of Architecture in Partial
Fulfillment of the Requirements for the Degree of
Bachelor of Science in Art and Design
in Architectural Design

at the
Massachusetts Institute of Technology

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ABSTRACT

A study was performed to determine how drawings for streets may be tailored to a broad range of viewers and agendas, yet still be viewed as a credible design tool for architects. With a growing number of cities designing their own guidelines according to the Complete Streets movements, it's necessary to develop a graphic style that not only appeals to the typical engineering aspect of streets, but is also robust enough to include details for various design components and spatial qualities not before considered in street design.

New drawings and information graphics were invented to better describe multi-modal streets, spatial qualities, and a fully conceived taxonomy of urban street types. It was discovered that three drawing types are especially useful for conveying this type of information: Perspective-Sections, Overhead Views, and Transects.

Thesis Supervisor: John A. Ochsendorf
Title: Associate Professor, Building Technology
How can street drawings be tailored to a broad range of viewers and agendas, yet still be a credible design tool?
# Complete Drawing Prototypes
For Urban Complete Streets

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This study began as a work-study with Utile Design Inc. in February of 2010. With the Boston Transportation Department as its client, Utile was commissioned to design the booklet and graphics for the new Boston Complete Streets Guidelines. In order to complete the task, a research-based analysis of appropriate street graphics seemed an appropriate way to ensure Boston’s complete streets guidelines outshined that of any other city.
what are complete streets?

As defined by the BTD, complete streets are multimodal, green, and smart. Essentially, it means that all mode-types, ecological methods for storm water drainage, and real-time traffic sensing are utilized in street design.

what are complete drawings?

Complete drawings are robust enough to handle all the different kinds of data and spatial information of streets. They are also accessible enough to be legible to a broad audience of designers, engineers, lobbyist, politicians, and every-day street users.
Initially, a number of existing graphic precedents are researched to identify the current scope of street representation. These include plans, sections, street perspectives, icons, section perspectives, overhead views, and transects. Green dots denote drawings especially useful for representing complete streets.
Level of detail must be appropriate to the drawing's scale

Linework should be avoided due to legibility and printing issues. Simplify linework radically and use fields as much as possible.
COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS
Photographs are useful for showing that innovative practices have been implemented, BUT they have two major drawbacks; use drawings or photomontage techniques instead of photographs.

Eye-level perspective drawings should be used to describe the pedestrian experience and details that are not legible in other drawing types.
Most valuable drawing type for describing the defining characteristics of a street

Simple, diagrammatic sections of multiple streets, aligned vertically, enable quick comparison of street types.
SECTION THROUGH CYPRUS SWAMP

Because of the proximity of the water on site, the Cypress Swamp was designed to use water falling on the site.

COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS
Even a minimal amount of receding space can have a significant impact in aiding legibility.

"Up to 47 percent of surface pollutants can be removed in the first 15 minutes of a storm event, including pesticides, fertilizers, and biologically derived materials and litter. In order to prevent these pollutants from entering our streams and rivers via the conventional piped stormwater system, areas for infiltration and treatment should be created. Providing pervious surfaces that capture stormwater runoff increases opportunities for pollutant removal and attenuation of flow velocity."

Green Streets: Innovative Solutions for Stormwater and Street Storms.
COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS
Choose a view/angle that maximizes exposure of ground plane

Drawings in 3D tend to be more interactive and captivating because they can contain more information than 2D drawings.

Especially useful for describing intersections.

Simple three-dimensional representations can allow reader to orient themselves much more quickly.
COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS
### SPECIAL FEATURE
Water feature in constant change. A spectacular attraction.

### ACTIVITY SPACE
Open space for public events and activity.

### COMMERCIAL ACTIVITIES
Outdoor cafes and outdoor commercial spaces

### PASSIVE RECREATION
Public seating

### ACTIVE RECREATION
Sports and leisure activities.

### DESIRE LINES
Clear space for pedestrian access and flows.

### FUNCTIONS & ENTRANCES
Seek out opportunities to represent systems, networks and processes visually in order to enhance the reader's comprehension.

Minimize cross-referencing
COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS
Below - When designing the guideline book for complete streets, it's important to note the following organizational hierarchies. The focus of this study will be on section 1, the drawings and diagrams of streets.

Right - The infographic Describes the various lessons learned concerning design of graphics for streets.
Use color and/or page tabs to aid frequent readers in navigating the document. Integrate these elements with the table-of-contents and/or index.

Minimize cross-referencing

Seek out opportunities to represent systems, networks and processes visually in order to enhance the reader's comprehension.

Use color to help articulate the brand identity of the entire document.

The document should be engaging and easy-to-use; it should not look like a manual or final report. It must function as both a storytelling piece and a reference guide.

Level of detail must be appropriate to the drawing's scale.

Choose a view/angle that maximizes exposure of ground plane.

Most valuable drawing type for describing the defining characteristics of a street.

Even a minimal amount of receding space can have a significant impact in aiding legibility.

- Use eye-level perspective drawings to focus on the drawing's auditory context, all other images should be logically placed to enhance the reader's experience.
- Use plan, section, perspective, and transverse diagrams to enhance the reader's understanding.
- Use color to enhance legibility and reflect the layout.
What is Everyone’s Graphic Common Ground?

2D Space
Accurate Dimension Specification
Engineering and Design Tool

COMPLETE DRAWING

3D Space
Immediate Experiential Street View
Enticing Spatial Understanding

PLANS

SECTION

PERSPECTIVE SECTIONS

OVERHEAD VIEW

TRANSECT

STREET VIEW

Two-Point Parallel Projection, Perspective
Parallel Projection
Viewing Preferences

- Plans
- Sections
- Perspective Sections
- Overhead View
- Transect
- Street View

Urban Planner
Architect
Transit
Engineer
Landscape Urbanist
The following graphics demonstrate isolated, hypothetical representations of different street configurations, all tailored to show different information regarding streets. The drawings are derived from the lessons learned from the precedent studies. (Graphics were created with Google Sketchup 7 and Adobe Illustrator and Indesign CS4.)

Section-Perspective
- minimal amount of receding space can have significant impact on legibility
- legend shows range of possibilities for street items that could be called out
- graphic is sensitive to facade permeability

Overhead View
- great for intersection detailing
- information called out directly on drawing
- capable of showing travel mode densities
- linework generally avoided for legibility/scalability concerns

Transect
- gradient across time

Boston Complete Streets
- various highlighting strategies
COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS

PERSPECTIVE SECTION as informational legend graphic

1
Average Daily Traffic
- Avg Daily Traffic: 800-1200
- Car: yes
- Bus: yes
- Light Rail: no
- Bicycle: yes
- Pedestrian: yes
- Avg Motor Speed: 25 mph

2 Vision
- Multimodal
- Green
- Smart
- Streets as Great Public Spaces
- Mostly brick pavers
- Granite details
- Minimal asphalt

3 Roadway Design
- 3.0 Principles
- 3.1 Travel Lanes & Widths
- 3.2 Motor Vehicle Speeds
- 3.3 Bicycle Facility Types
- 3.4 Transit Lanes
- 3.5 Medians

4 Intersection Design
- 4.1 Principles
- 4.2 Multi-modal Performance Evaluation
- 4.3 Crosswalks
- 4.4 Geometric Designs
- 4.5 Signals

5 Sidewalk Realm
- 5.1 Principles
- 5.2 Sidewalk Zones & Widths
- 5.3 Accessibility

6 Landscaping
- 6.1 Principles
- 6.2 Street Trees
- 6.3 Planting & Plant Lists
- 6.4 Rain Barrels
- 6.5 Bike-Swales
- 6.6 Paving Materials

7 Kerbside Management
- 7.1 Principles
- 7.2 Vehicle Parking & Loading Zones
- 7.3 Scooter & Motorcycle Parking
- 7.4 Bicycle Parking
- 7.5 Bus Stops
- 7.6 Meters

8 Smart Technology Principles
- 8.1 PTZ Cameras and Fiber Conduit
- 8.2 Electric and Hybrid Vehicles
Crossing the street is a breeze, and there are plenty of places to stop, rest, and shop!

Uniform paving for pedestrian and vehicle surfaces at intersections.

Traffic calming slows overall vehicular flow, but buses report more reliable stop schedules.

Safe vehicular cycling in slow rate of traffic even though not specifically designated for bike lanes.

A New Urbanist’s Dream! Appropriate scales and small shops allow for relaxed, pedestrian atmosphere.

Vegetation is creatively deployed to calm traffic and unify public spaces.

No immediate parking, but the drive is pleasant and the way is marked by thoughtful use of materials rather than painted lines and signs.
Past Trends
- Shared Streets
- Dirt and Clay Pavement
- Slow and Simple Travel Modes
- Nature as Commodity
- Opaque Building Facades as Wall to Sidewalk Realm

Future Trends
- Lane Use and Ownership Designated
- Diverse and Durable Paving Types
- Fast and Diverse Travel Modes
- Nature as Drainage Infrastructure
- Increasing Facade Permeability to Sidewalk Realm

200 yrs of a
BOSTON URBAN STREET

1860
- Steam Road Roller
- Tree Shade as Ornamentation (Ottawa)

1872
- First Asphalt (NYC)

1890
- Sand Clay Roads (South Carolina)

1900
- Coal Tar Experiments (NYC)

1908
- Ford Model T Introduced

1909
- Concrete Road (Michigan)

1910
- City Planning of Streets and Lots
- Peak in Urban Greenery
- Parking Meter

1943
- Great American Streetcar Scandal

1949
- Federal Highway Administration

1962
- Walk/Don't Walk Signs Invented

1961
- Subdividing for Traffic Safety (ITE)

1965
- Traffic Engineers Handbook (ITE)

1967
- National Committee on Uniform Traffic Laws and Ordinance

2008
- New York City Street Design Manual

2000
- Deployment of Dedicated Cycle Lane Network (Boston)

2011
- Boston Complete Streets Guidelines

2010
- First Asphalt (NYC)

2060
- Concrete Road (Michigan)

Street Name Inspirations
- Landmarks, Heroes

Examples
- Church St, Washington St
- Commonwealth Ave
- Longfellow Ave
Case Studies in BOSTON COMPLETE STREETS

Roadway design in Boston is a complex endeavor due to narrow rights-of-way and competing needs of users. This study primarily covers street design between curbs—that is, travel lanes that are used by bicycles, automobiles, trucks, and transit vehicles.

**Principle 1**
Street space shall be optimized, with a priority on reducing

**Principle 2**
Streets will be designed to
For a standard of comparison, a Boston complete street design is represented by traditional two-dimensional drawings. The next page demonstrates the same information reproduced in a single, section-perspective graphic.
Plan and Sectional information of a hypothetical cycle track configuration in Boston
Optimizing Use of Street Space

1. Determine if the street is a candidate for a **road** diet:

   ![Road Diet: Remove Lanes]

2. Determine if the street is a candidate for a **lane** diet:

   ![Lane Diet: Reduce Lane Widths]
Minimum Lane Width

Most City streets should be designed to produce an operating speed of 25 miles per hour.

### Motor Vehicle Travel

<table>
<thead>
<tr>
<th>Description</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-way left turn lane (TWLTL)</td>
<td>10ft/10ft</td>
</tr>
<tr>
<td>Peak hour restricted parking lane</td>
<td>12ft/12ft</td>
</tr>
<tr>
<td>Inside travel lane</td>
<td>10ft/10ft</td>
</tr>
</tbody>
</table>

- **Travel lane adjacent to on-street parking:**
  - Shared use lane: 10ft/12ft
  - Adjacent bicycle lane available: 10ft/10ft
- **Travel lane adjacent to curb, no parking:**
  - Shared use lane: 10ft/12ft
  - Adjacent bicycle lane available: 10ft/12ft

### Bicycle Lanes

<table>
<thead>
<tr>
<th>Type</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle lane - parking permitted</td>
<td>5ft/10ft</td>
</tr>
<tr>
<td>Bicycle lane - parking not permitted, curb</td>
<td>4ft/5ft</td>
</tr>
<tr>
<td>Bicycle lane - parking not permitted, no curb</td>
<td>4ft/10ft</td>
</tr>
</tbody>
</table>

### Other Lanes

<table>
<thead>
<tr>
<th>Type</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking lane</td>
<td>7ft/7ft</td>
</tr>
<tr>
<td>Bus-only lanes</td>
<td>NA/11ft</td>
</tr>
<tr>
<td>Bus and bicycle lanes</td>
<td>NA/12ft</td>
</tr>
</tbody>
</table>
Mid-Block Center Median Configuration
Intersection Travel Mode Study
COMPLETE DRAWING PROTOTYPES FOR URBAN COMPLETE STREETS
CONCLUSIONS

The graphics derived in this study are useful for designers engaging in discussions about Complete Streets with any combination of other designers, engineers, politicians and street users.

Software like Sketchup and Illustrator can be used to easily swap library components and share street design ideas.

As an Architectural Design student, this street space study was incredibly useful for understanding a building's street context, an aspect often ignored in architecture education.