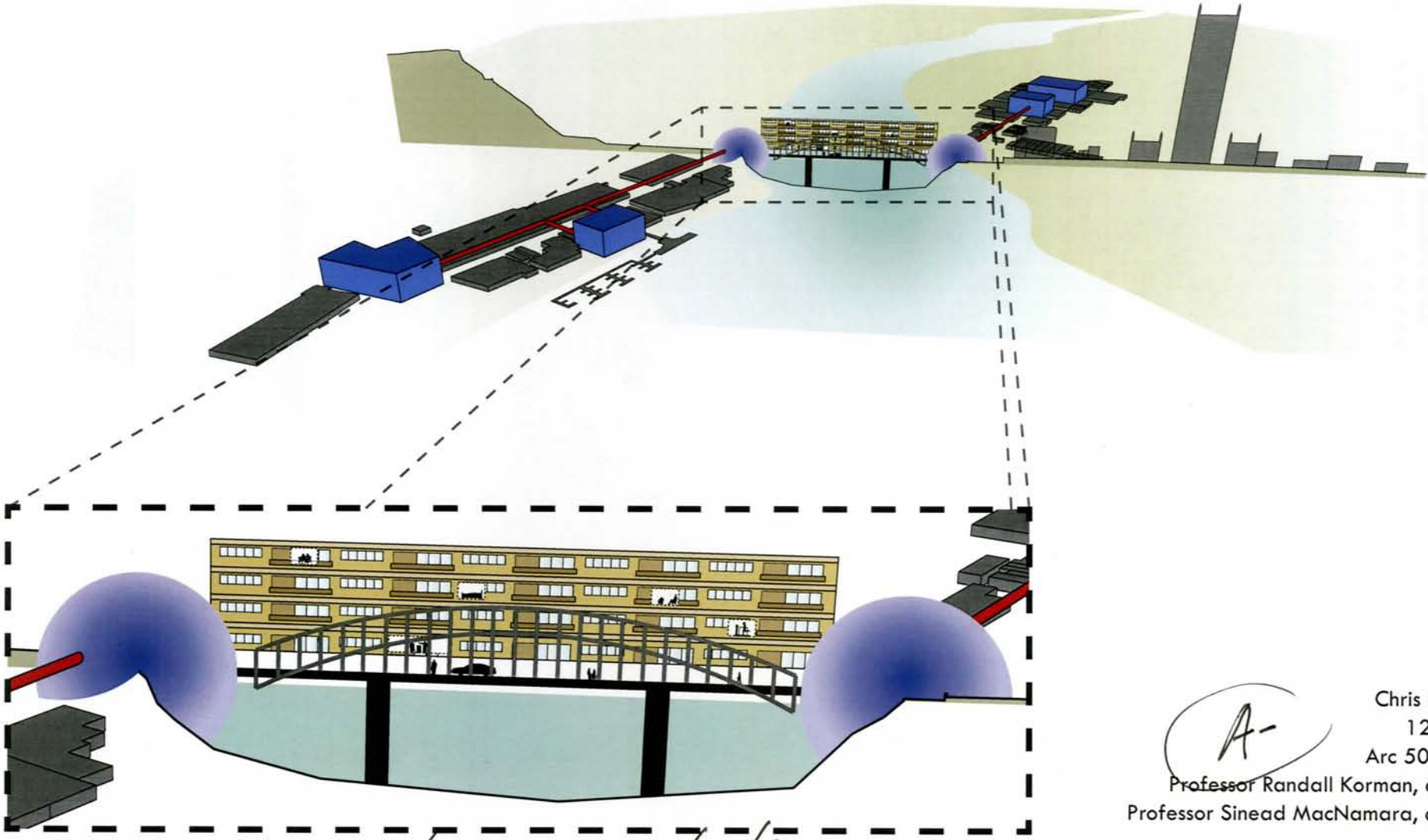
Spring 2010

Bridge_Works

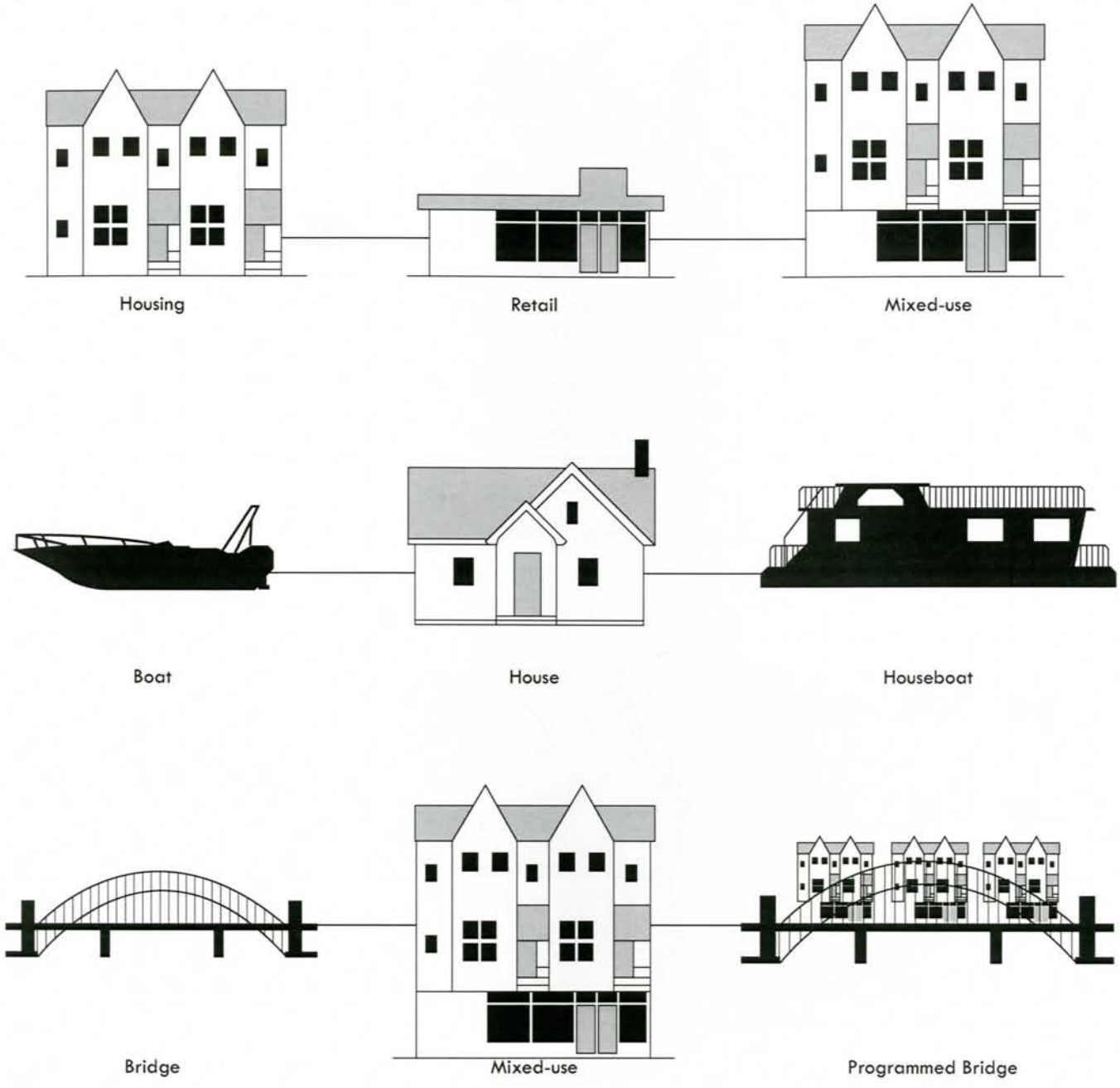
Chris Driscoll
Syracuse University

Bridge_Works

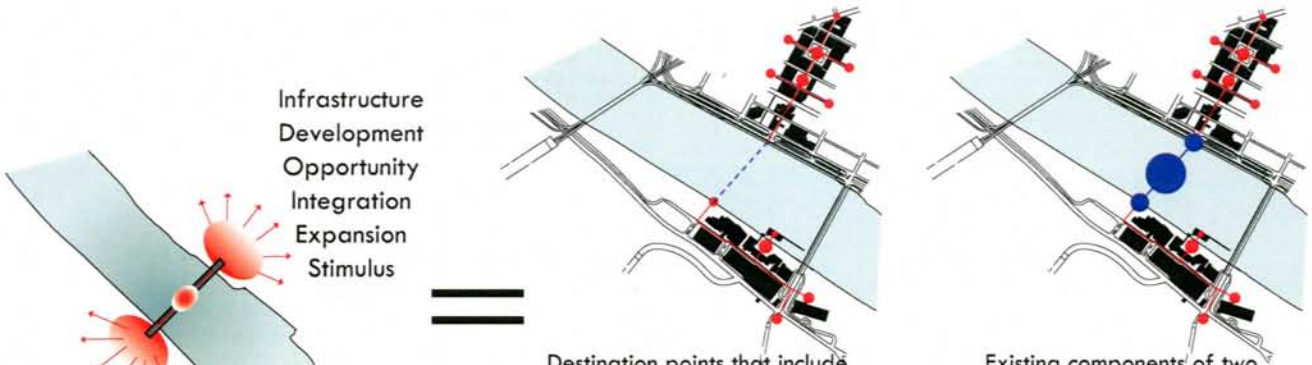


Property of Randall J. Korman

Chris Driscoll
12.14.09
Arc 505/508
Professor Randall Korman, advisor
Professor Sinead MacNamara, advisor



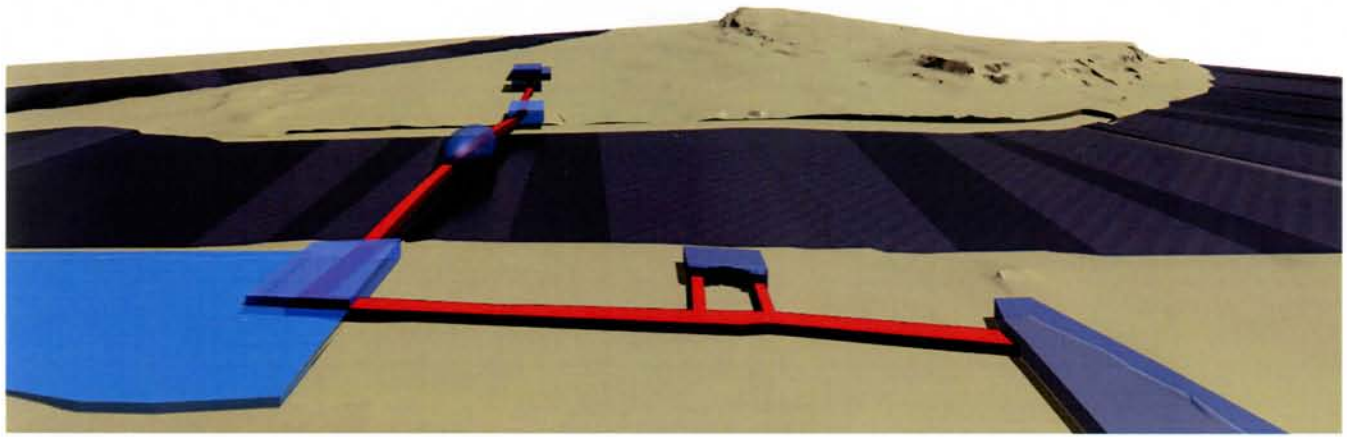
Building typologies are generally well defined and functionally specific. A church is for worship, a house is for living and a theater is for performing. In certain instances, these basic building typologies have been combined to form composites structures such as mixed-use housing/retail projects, or a house on a boat. The opportunities created by composite typologies have allowed for broader economic development, more complex and integrated programming, greater utility and richer social structures. A specific combination of typologies – the mix of infrastructural bridge with housing/retail/public space – has produced a few historically successful models. The Ponte Vecchio in Florence, Italy is an archetypal programmed bridge that is integrated into the urban fabric of the city. Public and private circulation, along with retail and housing functions are integral to the design of this famous structure. Over time, the bridge was developed from a simple viaduct to become part of the urban infrastructure of Florence and cultural and social life along the Arno River.



Destination points that include commercial, residential, infrastructural and cultural components are anchored already on either side of a waterway. A possible connection exists between two anchor points.

Existing components of two destination points converge onto nodal points along the water. These nodal points are where a new destination point may arise from over the waterway on the infrastructure of a bridge.

Abstraction → Applied to → Setting → → Realization

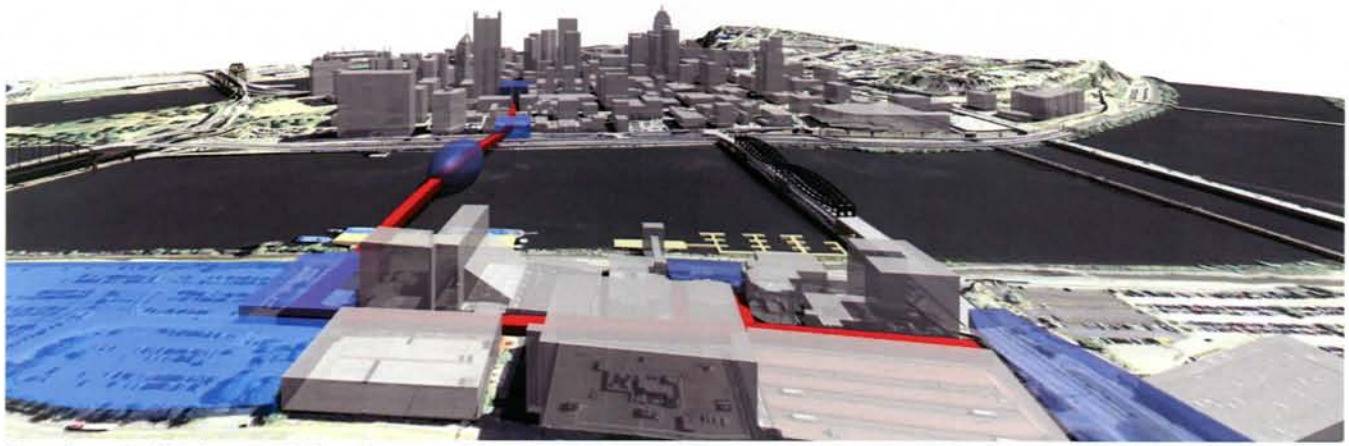


View of Urban Sequence Connected through Programmed Bridge to New Nodal Points (light blue) and Existing Public Space (blue)

By taking this historic composite typology and redeploying it within a contemporary urban context, it is possible to address a series of related architectural and urban issues simultaneously. These issues/objectives are:

1. The composite typology of bridge, housing and mixed-use (retail/commercial) functions creates a synergistic relationship among the individual program types that enriches the whole.
2. An economy of means is accomplished by combining a normally stand-alone infrastructural element (i.e. a bridge) with other building types (i.e. housing).
3. The insertion of the programmed bridge into a site changes the traditional role of bridge as merely infrastructure for automobiles into a new destination within its context affording the bridge the inherent opportunity to create new civic space.
4. The two places where this new bridge type touches down can now operate as both the end points and nodal instigators. They offer the opportunity to stimulate urban growth by projecting new activity, programming and users into pre-existing static site condition.
5. Where these site conditions are part of two previously disconnected urban sequences, the inhabited bridge now offers the opportunity to join these sequences into a greater and more significant whole creating a spatial continuity between two disparate parts of the city.

Existing View from Mt. Washington: Pittsburgh, PA Skyline



View from Mt. Washington: Urban Sequence through Nodal, Destination and Public Space

An ideal test site for a project such as this would be a city that remains disconnected from its parts despite the presence of the bridges. It should also have waterways adjacent to moribund urban areas that need only a small spark to be spatially reactivated. However, the context should not be so derelict to be absent of opportunity. With its rich history, culture and social mix, Pittsburgh, Pennsylvania is an ideal site. Its great number of existing bridges and the growing resurgence in downtown activity provides an appropriate context in which to deploy this composite typology.

Once bustling market areas and retail-focused streets are now full of struggling businesses and occupancies tailored to short-termed use. Market Square – one of the largest open spaces in the center of Pittsburgh – does not have the necessary means to retain people there after the business lunch hour. An inhabited bridge linking Pittsburgh's downtown to a cross-river destination could contribute to the resurgence of the city as an urban destination.

Pittsburgh Pirates Fans; Downtown Parking; Commuters; Pedestrians; Pre-game Downtown

Roberto Clemente

Bridge

Pittsburgh Pirates Fans; Major League Baseball Game; pedestrians; Pre-game North Shore; North Shore

Oakland; Phipps Conservatory; University of Pittsburgh; Culture; Education; Nightlife

Panther Hollow

Bridge

Schenley Park; Leisure; Culture; Entertainment; Sports; Outdoor Activity

South Hills; Suburbs; Residential; Commuters

Panhandle

Bridge

Downtown; Firstside; Public Transportation; Work; Culture

South Hills; Suburbs; Residential; Commuters

Liberty

Bridge

Downtown; Oakland; Pennsylvania Turnpike; Travel; Work; Culture

South Shore; Station Square; Mt. Washington; Residential; Culture; Commuters; Nightlife

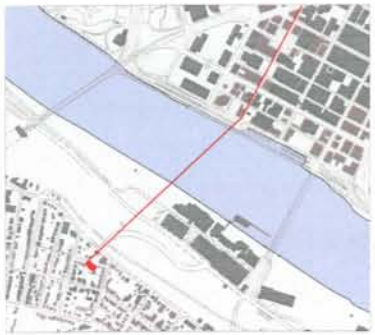
????????

?

Bridge

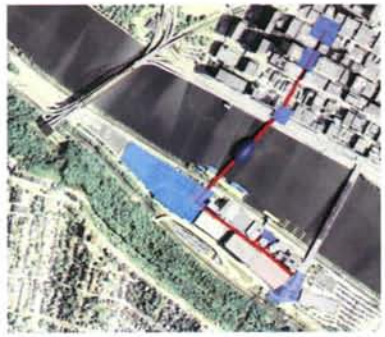
Downtown; Market Street; Retail; Work; Culture

Another important reason to use Pittsburgh as a site stems from an integral part of Pittsburgh's infrastructure, history and aesthetic appeal. Pittsburgh has over 400 bridges – competing with the international city of bridges, Venice – but each one serves strictly an infrastructural purpose for the city. The precedent of bridge and use is already in place in the city. Whether the bridges are linking infrastructure such as railway, highways and tunnels or connecting a working class neighborhood to the city center, the bridges of Pittsburgh are important to the city's ability to function. This fact should be seen as an opportunity to help with the city's problem of activating its urban center again. The natural link that a bridge makes from one side of a river to another – connecting activities, transportation routes, businesses, etc. - along with the challenge of the composite typology applied to a modern city creates a unique architectural design problem within a spatially enriched site.

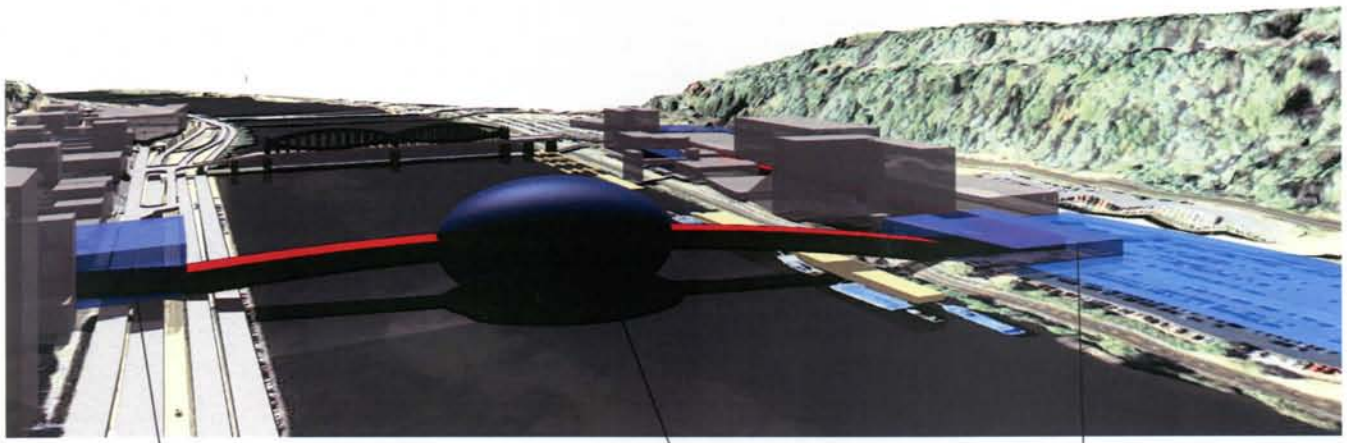


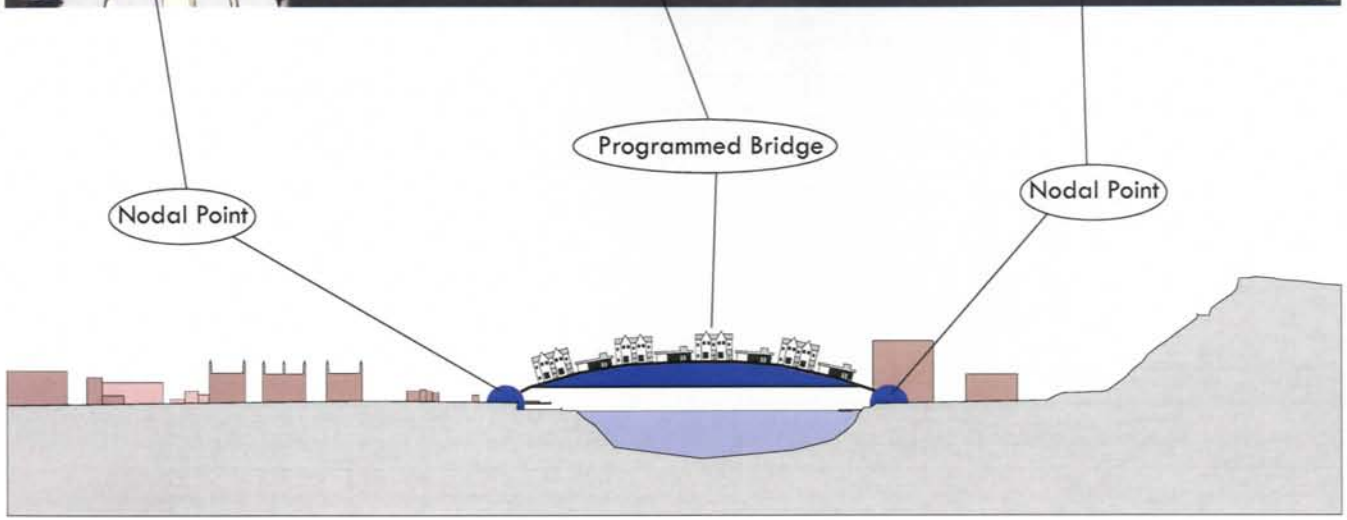
Site Plan
(diagrammatic
section cut shown)

source: Mark Mimram



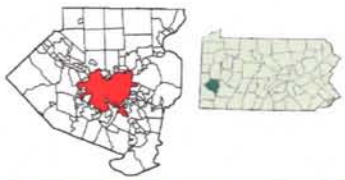
Site Plan
(diagrammatic
rendering)





An inhabitable bridge strategically placed in Pittsburgh offers the opportunity to enrich the urban fabric, expand the urban linkages and connect the opposite shore to the urban center. By introducing a population cohort into this part of the city it creates human activity where previously there was none. With placement close to downtown and a strong peripheral area, Pittsburgh's struggling downtown housing market would be re-energized creating a draw to live, work and play downtown again. The endpoints of the bridge have the capacity to create nodal points of new urban/spatial development and activity. An inhabited bridge can demonstrate that the redeployment of a historical typology has relevance in a contemporary urban setting. It will extend the tradition of bridge-making in Pittsburgh while also creating a new infrastructural model in collaboration with architectural design.

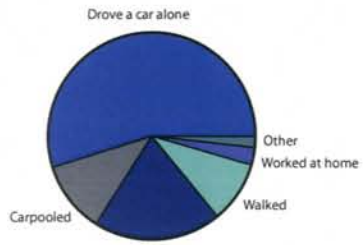
http://www.flickr.com/photos/sduffy/2343950216/



Pittsburgh as Melting Pot:
African American: Hill District and Homewood
Jewish: Squirrel Hill
Italian: Brookline, Bloomfield, Morningside, Oakland and Beechview
German: Troy Hill, Mt. Washington, Larimer, and East Allegheny (Deutschtown)
Polish and other Eastern European: South Side, Lawrenceville, and Polish Hill
Irish: Upper Lawrenceville, Swishhelm Park, and Duquesne Heights

Fortune 500 Companies:
84 Lumber
Alcoa
Allegheny Technologies
American Eagle Outfitters
Bayer Corporation
Calgon Carbon Corporation
FreeMarkets
Heinz
Mellon Bank Corporation
PNC
PPG Industries
WESCO International
Westinghouse Electric
U.S. Airways
USX

Mode of transportation to work in Pittsburgh, PA



Daytime population change due to commuting: +138,191 (+41.3%)
Workers who live and work in this city: 98,005 (69.1%)

RECOVERY CITY RANKING	MSA	GMP RANK	UNEMPLOYMENT RANK	HOME PRICE RANK	FORECLOSURE RANK	SALES RATE RANK
1	Omaha-Council Bluffs, NE-IA Metro Area	33	1	12	8	16
2	San Antonio, TX Metro Area	13	14	8	36	2
3	Austin-Round Rock, TX Metro Area	2	18	17	35	15
4	Pittsburgh, PA Metro Area	46	24	2	12	5
5	Harrisburg-Carlisle, PA Metro Area	51	23	37	3	32
6	Dallas-Fort Worth-Arlington, TX Metro Area	25	35	4	51	16
7	Rochester, NY Metro Area	47	30	22	9	18
8	Houston-Sugar Land-Baytown, TX Metro Area	53	40	1	43	32
9	Raleigh-Cary, NC Metro Area	22	42	32	22	30
10	Baton Rouge, LA Metro Area	58	14	9	15	75

Top Ten: America's Fastest Recovering Cities
"We ranked September unemployment rates (the most recent available by metro) using data from the Bureau of Labor Statistics; the percentage of a metro's homes in foreclosure with September data provided by RealtyTrac; and the change in GMP between the first and second quarter of 2009 from the Brookings Institution's MetroMonitor. We also included the second-quarter 2009 year-over-year change in Freddie Mac's (FRE - news - people) Conventional Mortgage Home Price Index--a measure of housing price inflation--and the average days on the market for properties currently on sale (to measure sales rates), using data from Zillow.com. We then averaged the scores for each measure to arrive at an overall ranking." - Forbes.com, 11/19/09

City of Pittsburgh

Nickname(s): City of Bridges, Steel City, Iron City

Coordinates: 40°26'30"N, 80°00'00"W

Country: United States
Commonwealth: Pennsylvania
County: Allegheny
Area Code: 412
Settled: 1717
Incorporated: April 22, 1794 (borough), March 18, 1816 (city)

Area:
- City: 58.3 sq mi
- Land: 55.5 sq mi
- Water: 2.8 sq mi
- Metro: 5,343 sq mi

Elevation: 1,223 ft

Population (U.S. Census Estimate, 2006):
- City: 316,718
- Density: 5,636/sq mi
- Metro: 2,462,571
- Demonym: Pittsburgher

Major Economic Sectors: medical services, research and technology, government, wholesale and retail trade, manufacturing

Major Colleges and Universities: University of Pittsburgh; Carnegie Mellon University; Duquesne University

Source: Wikipedia; City-data.com

1754 George Washington secures a British outpost at the Point.

1761 First record of coal mining in Pennsylvania on Coal Hill (now Mount Washington), across the Monongahela River from Fort Pitt.

1764 John Campbell, a trader and businessman, mapps out four blocks of Pittsburgh, including Market Square.

1787 Pittsburgh Academy incorporated. Direct ancestor of the University of Pittsburgh.

1816 Pittsburgh incorporates as a city

1845 The fire of 1845 destroys most of the buildings in Pittsburgh.

1870 The Monagahela Incline opens for business linking Mt. Washington residents to Downtown.

1883 The present-day Smithfield Street Bridge opens to the public. It's the third bridge built on that location.

1887 The Pittsburgh Pirates begin their career in major league baseball as the Pittsburgh Alleghenies

1889 Schenley Park, located in Oakland, opens to the public.

1895 Dedication of Carnegie Library November 5.

1900 Carnegie Technical School, now known as Carnegie Mellon University is founded.

1920 The first commercial radio station in the country - KDKA - broadcasts from Pittsburgh.

1927 The Pittsburgh Symphony is founded.

1936 The Great Flood causes extensive damage, especially to downtown Pittsburgh.

1946 The Civic Light Opera opens its first summer season.

1958 Gateway Clipper Fleet begins service.

1976 Pittsburgh and Lake Erie Railroad Station converted into a mixed-use development call Station Square

1984 PPG Place is complete adding a complementary outdoor plaza a block away from Market Square.

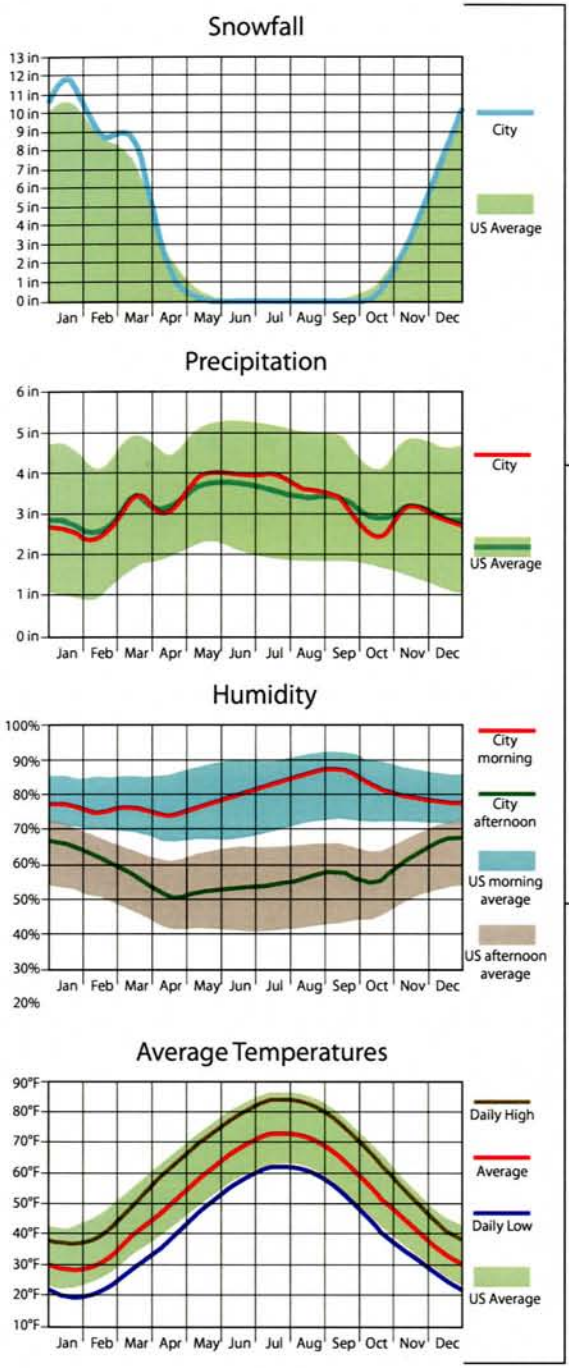
1984 Port Authority begins service of a light rail transit system call the "T".

1985 Pittsburgh is named "America's Most Livable City".

2000 PNC Firtside Center receives a LEED Silver certification - a benchmark for Pittsburgh's green movement.

2009 Pittsburgh is named "America's Most Livable City".

2009 Pittsburgh hosts the G-20 Conference.



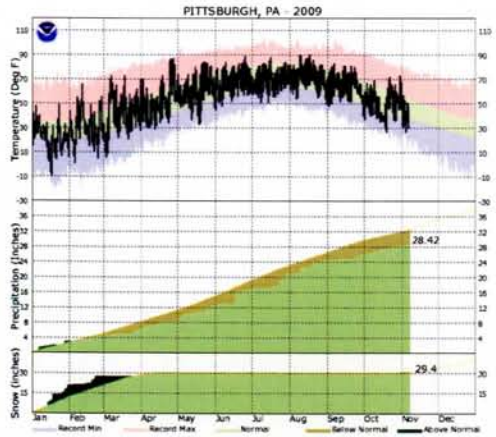


Chart of temperature, precipitation, and snowfall over the course of 2009. Data shows averages annually which helps to weigh the importance of weather fluctuations throughout a year in Pittsburgh.

Pittsburgh has minor fluctuations between weather patterns throughout seasonal change. Its climate ranges from humid subtropical to humid continental. Generally, Pittsburgh has cold snowy winters and warm humid summers with clouds and precipitation. The climate of Pittsburgh constrains the types of program that can be on a bridge. Over a river, the project would also be highly exposed to weather conditions of all kinds.

Several tables compiling annual data on Pittsburgh's climate. Useful as a resource to utilize when designing so that the project is capable of dealing with weather fluctuation and can take advantage of them.

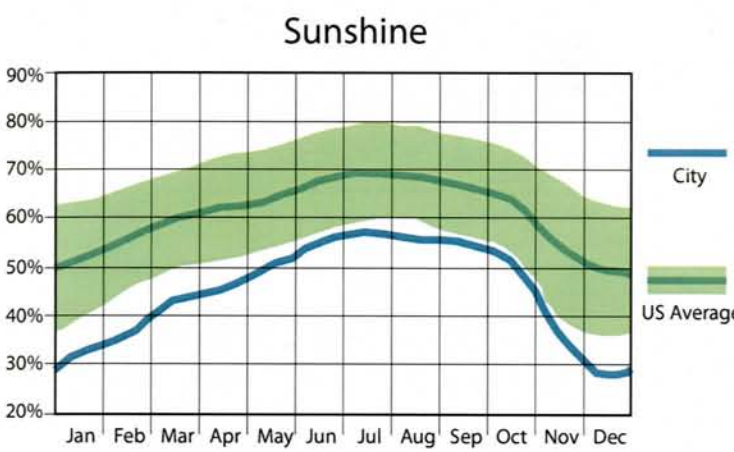
source: City-data.com

Variable	J	F	M	A	M	J	J	A	S	O	N	D
Insolation, kWh/m²/day	1.69	2.47	3.31	4.40	5.06	5.68	5.57	4.96	4.04	2.86	1.77	1.44
Clearness, 0 - 1	0.41	0.44	0.43	0.46	0.46	0.49	0.50	0.49	0.48	0.45	0.39	0.39
Temperature, °F	25.29	28.58	36.64	48.09	58.66	67.57	71.10	69.49	62.40	50.95	40.41	29.46
Wind speed, mph	11.43	11.23	11.27	10.36	9.24	8.66	7.76	7.63	8.57	9.48	11.05	11.39
Precipitation, in	2.61	2.50	3.51	3.41	3.85	3.94	4.16	3.50	3.20	2.57	3.07	3.00
Wet days, d	16.4	14.0	15.1	13.7	13.0	11.8	10.6	9.9	10.1	10.7	13.4	16.6

Table of several solar and climate related data types for Pittsburgh, PA

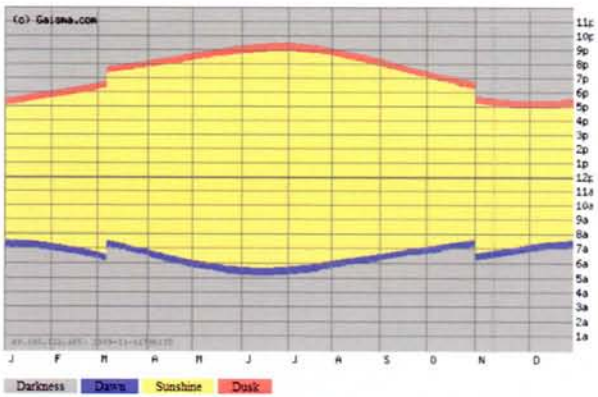
Weather data for Pittsburgh, Pennsylvania													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °F (°C)	75 (24)	77 (25)	84 (29)	90 (32)	95 (35)	98 (37)	100 (38)	103 (39)	99 (37)	91 (33)	82 (28)	74 (23)	103 (39)
Average high °F (°C)	32 (0)	34 (1)	47 (8)	59 (15)	71 (22)	79 (26)	83 (28)	81 (27)	74 (23)	63 (17)	51 (11)	39 (4)	59 (15)
Average low °F (°C)	19 (-7)	22 (-6)	30 (-1)	39 (4)	49 (9)	58 (14)	62 (17)	61 (16)	54 (12)	43 (6)	34 (1)	25 (-4)	41 (5)
Record low °F (°C)	-27 (-33)	-20 (-29)	-1 (-18)	11 (-12)	26 (-3)	34 (1)	42 (6)	39 (4)	31 (-1)	16 (-9)	-1 (-18)	-12 (-24)	-27 (-33)
Precipitation inches (mm)	2.59 (65.8)	2.47 (62.7)	3.24 (82.3)	3.07 (78)	4.04 (102.6)	3.93 (99.8)	3.90 (99.1)	3.15 (80)	3.13 (79.5)	2.35 (59.7)	3.05 (77.5)	2.86 (72.6)	37.85 (961.4)
Snowfall inches (mm)	12.3 (312.4)	8.5 (215.9)	7.9 (200.7)	1.5 (38.1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.4 (10.2)	3.1 (78.7)	6.9 (175.3)	40.6 (1,031.2)

Source: National Weather Service 2009-03-01



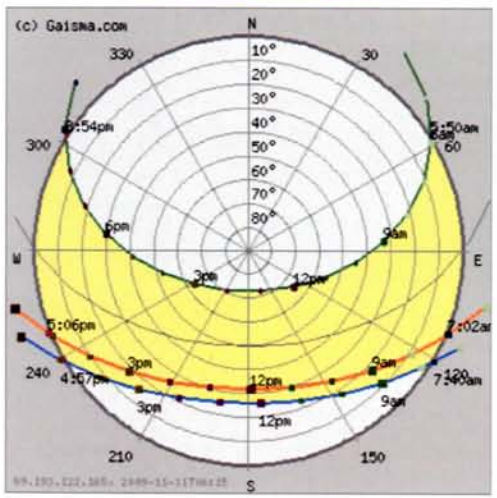
Pittsburgh, PA Sunshine

source: City-data.com



Pittsburgh, PA Sunrise, Sunset, Dawn and Dusk Graph

source: Gaisma



Pittsburgh, PA Sun Chart

source: Gaisma

Studying the sun's impact on the site in Pittsburgh is very important for several reasons. Since the majority of the proposed programmed bridge will be over open water, its exposure to sunlight is high at all times of the day. Understanding orientation of the sun's light throughout the days and seasons play into the solar orientation of program and space within the project.

9:00 am, July 1st, 2009

9:00 am, January 1st, 2009

12:00 pm, July 1st, 2009

12:00 pm, January 1st, 2009

3:00 pm, July 1st, 2009

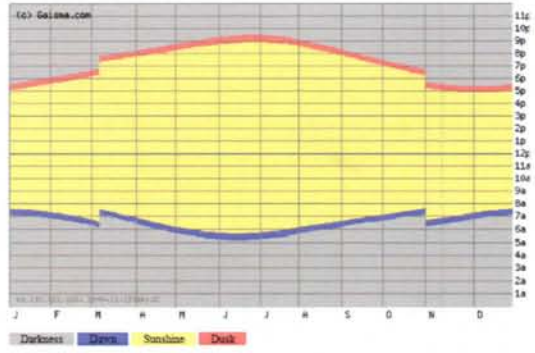
3:00 pm, January 1st, 2009

6:00 pm, July 1st, 2009

6:00 pm, January 1st, 2009

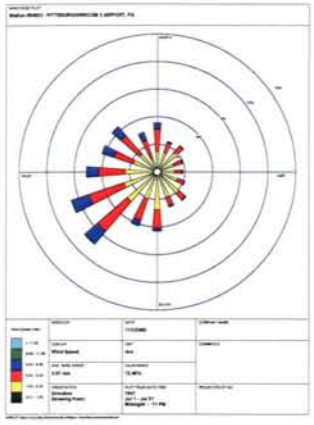
Preliminary Solar Study

Comparing sun exposure and shadow within the limits of the site and with two extremes of the year (June 1st vs. January 1st) produces a basic understanding of orientation. In order to maximize the possibilties of the sun and solar technologies the solar variances throughout the seasons in Pittsburgh, PA must be documented.



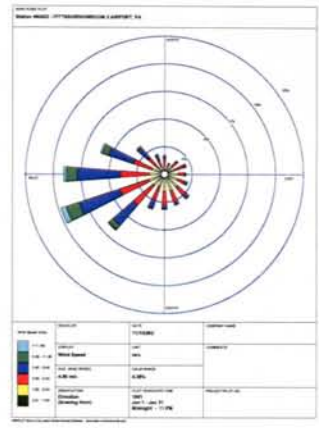
Pittsburgh, PA Sunrise, Sunset, Dawn and Dusk Graph

source: Gaisma

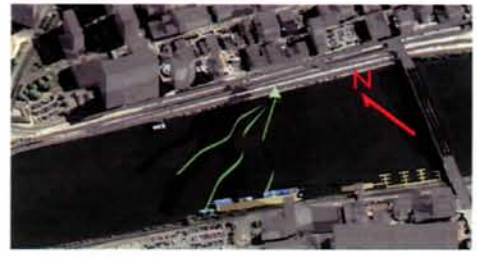


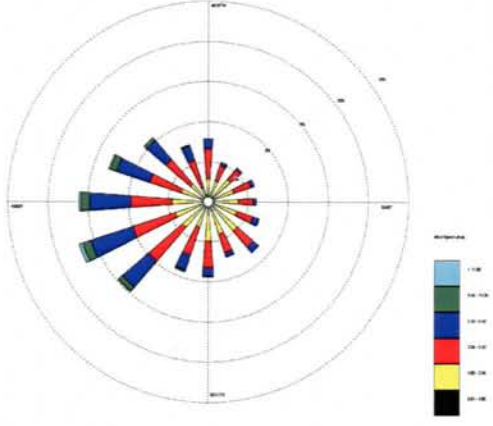
This is a comparision of the January wind rose and June. The is heavier wind in January, but it does not come from as many varied directions. This is good for weather-proofing a programmed bridge for the winters in Pittsburgh since generally the wind comes from one direction.

source: United States Department of Agriculture



These simple renderings compare the three strongest wind directions during January and June and how they fit directly within the site. It is important to note that the topography of the city, and its buildings, shape the wind's direction too.

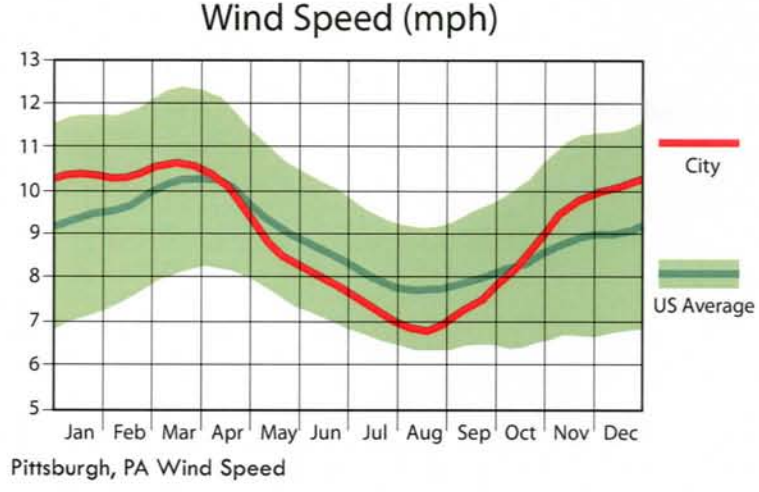




This wind rose for Pittsburgh, PA was formed from hourly wind data for every year from 1961 through 1990. It shows that the wind blows from the Southwest 13% of the year in Pittsburgh. For most of the year, the wind is blowing from the west. It is from this direction that the wind is typically the strongest, at speeds of 11.05 meters per second which is approximately 22 miles per hour.

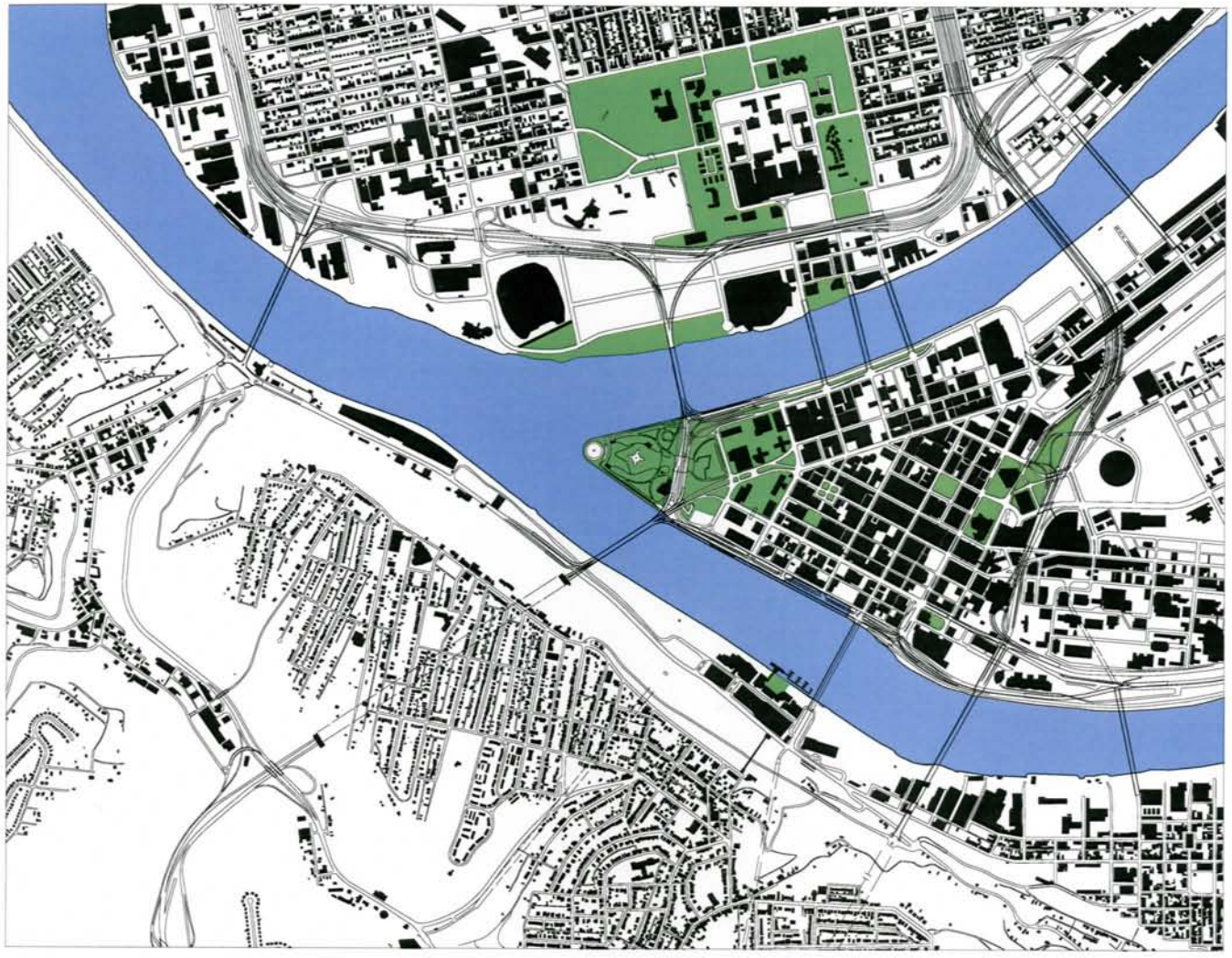
source: Pennsylvania State University College of Earth and Mineral Sciences

Wind through the river valleys of Pittsburgh is integral to the design of a proposed bridge project. Structurally, the bridge must be sound. Technologically, wind is an opportunity for sustainable energy. Comfort-wise, wind must not interfere with the daily lives of residents living, working and playing over the Monagahela River.



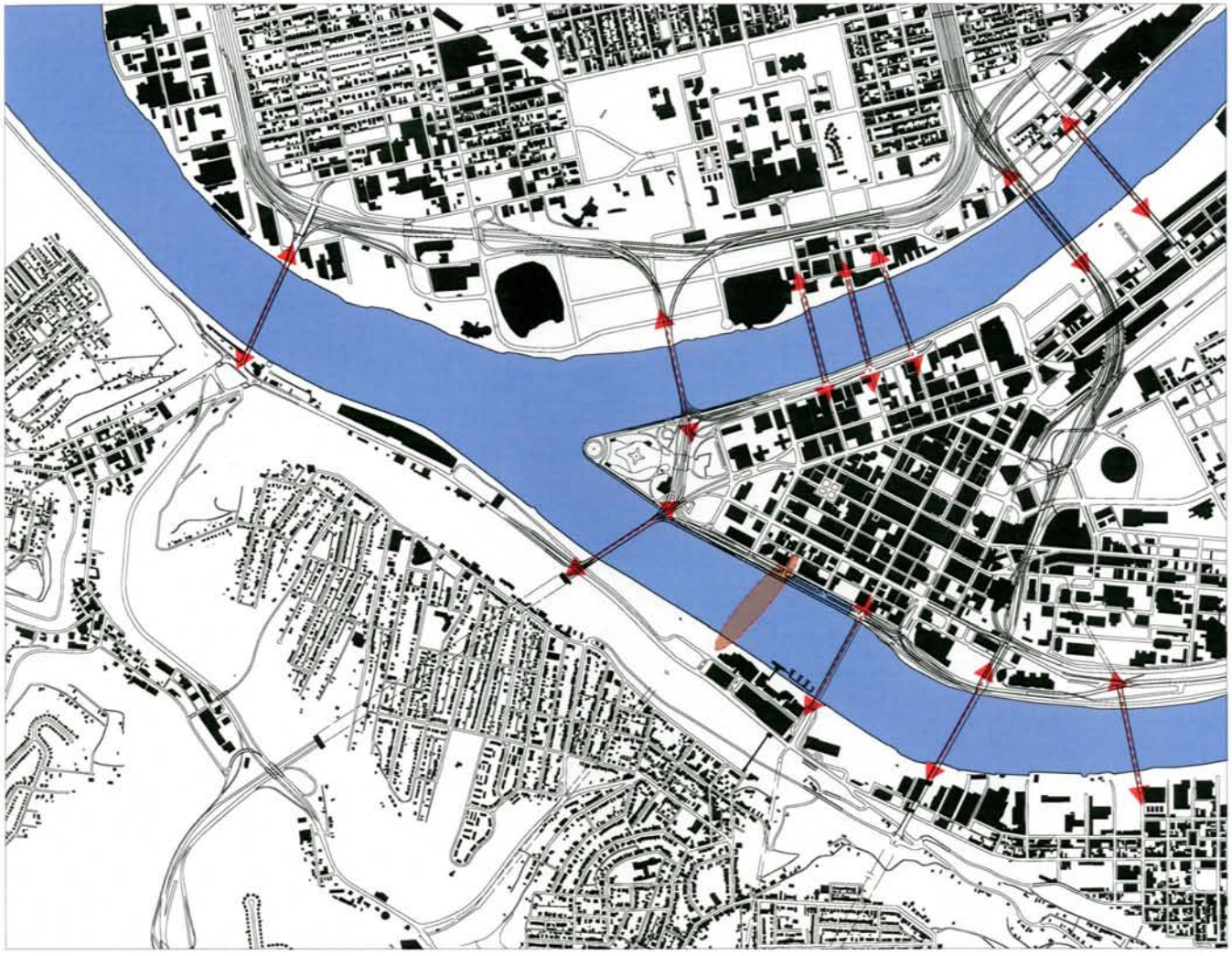
Pittsburgh, PA Wind Speed

source: City-data.com



The green (park) spaces and outdoor public spaces within Pittsburgh are quite diverse in size and use. Point Park is a large outdoor area at the convergence of the Three Rivers which allows for good vistas of the city and glimpses at Pittsburgh war-torn history. The other large park in the area is across the Allegheny River and engulfs the Pittsburgh National Aviary and Children's Museum - Allegheny Commons Park. Smaller areas exits within the downtown fabric of the city. Mellon Commons, Steel Plaza, Gateway Plaza, Firstside Park, PPG Plaza and Market Square are the primary public zones. Bessemer Court in Station Square and the North Shore are the waterfront green/outdoor spaces just outside of the city center.

Knowing how these parks and plazas connect to the other urban pieces of the city is integral to creating a new urban connection.



The bridges of Pittsburgh are an imprtant part of the city's cultural identity. Each bridge has its own story and infrastructural purpose. The primary bridges around the city center are highlighted in this map along with the proposed site for a new urban link. But, the total number of bridges on smaller scales or beyond the range of this map are pieces of the larger picture - Pittsburgh as the City of Bridges.

National Bridge Inventory (NBI) Statistics - Pittsburgh, PA:

Number of bridges: 715

Total length: 15,322 meters (50,269ft)

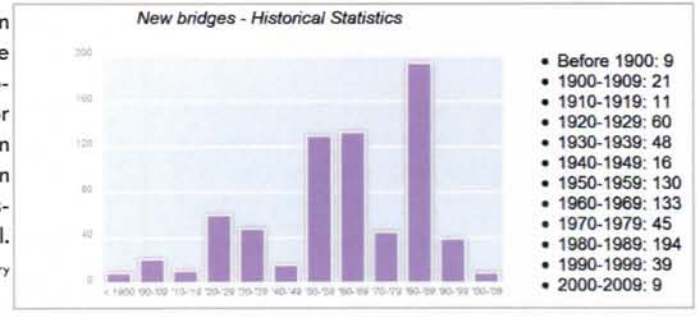
Total costs: $473,172,000

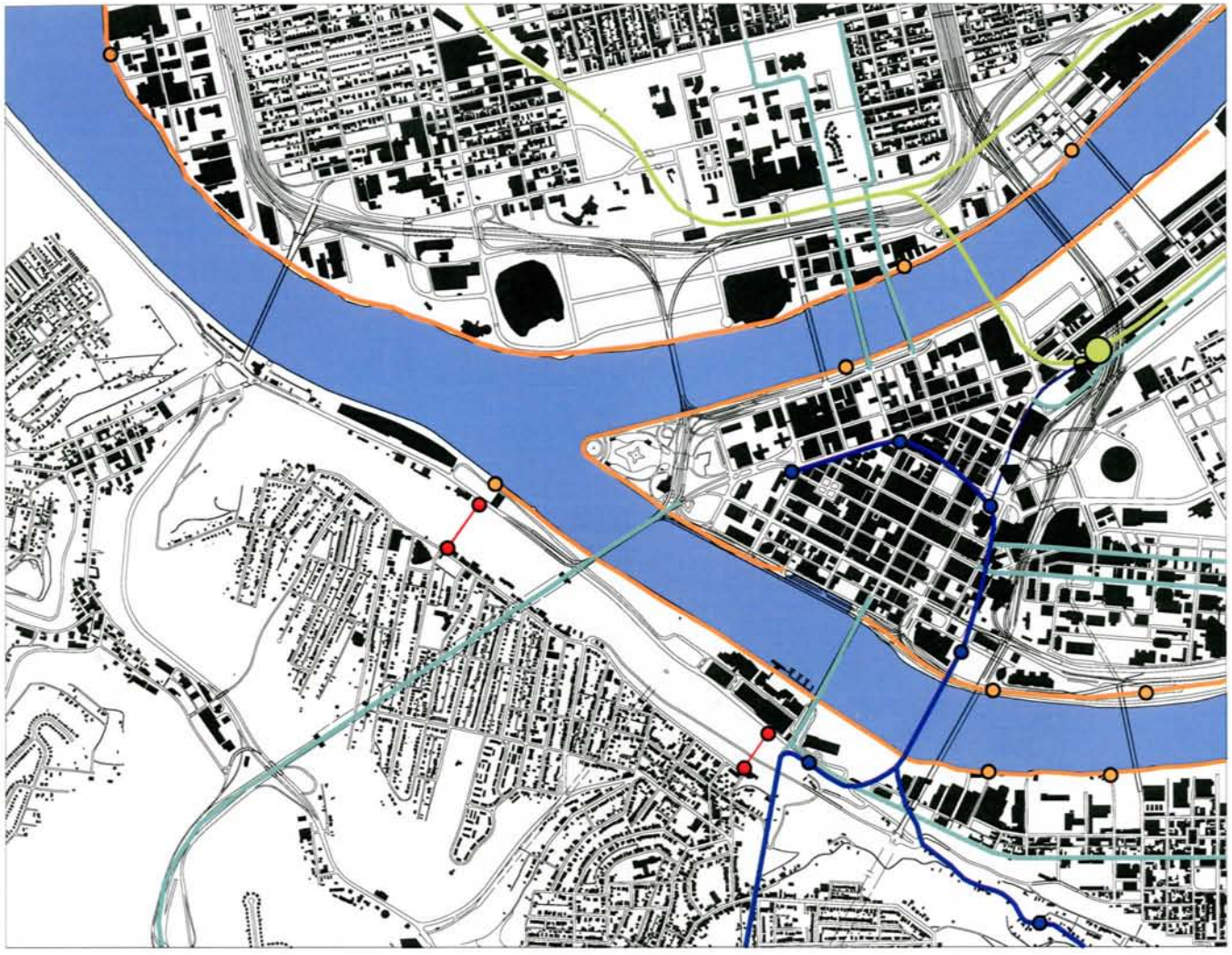
Total average daily traffic: 10,085,086

Total average daily truck traffic: 809,383

Seeing a visual representation of new bridge construction throughout Pittsburgh's history can be correlated dirrectly to the needs of urban expansion and the booming industrial economies. The slowdown in construction is due to the lack of need for new infrastructure of a purely transportational purpose. When coupled with other urban growth areas, or areas in need, it can be seen that a programmed bridge may help in regards to transporation infrastructure as well.

source: National Bridge Inventory





Primary Inbound/Outbound Bus Routes
Light Rail System with Stations
Mt. Washington Inclines with Stations
Bike Trail with Trail Access Points
Train Route with Penn Station

The public transportation infrastruce of Pittsburgh is an important resource for its inhabitants. With a large amount of commuters from outlying areas of the city, and the suburbs beyond, the economy's stability depends on it. The connectivity the infrastructure allows locally, nationally and internationally also helps to cement the city's purpose and importance to the national economy. With multiple types of public transportation within the city center is good for any new urban connection to tie into.

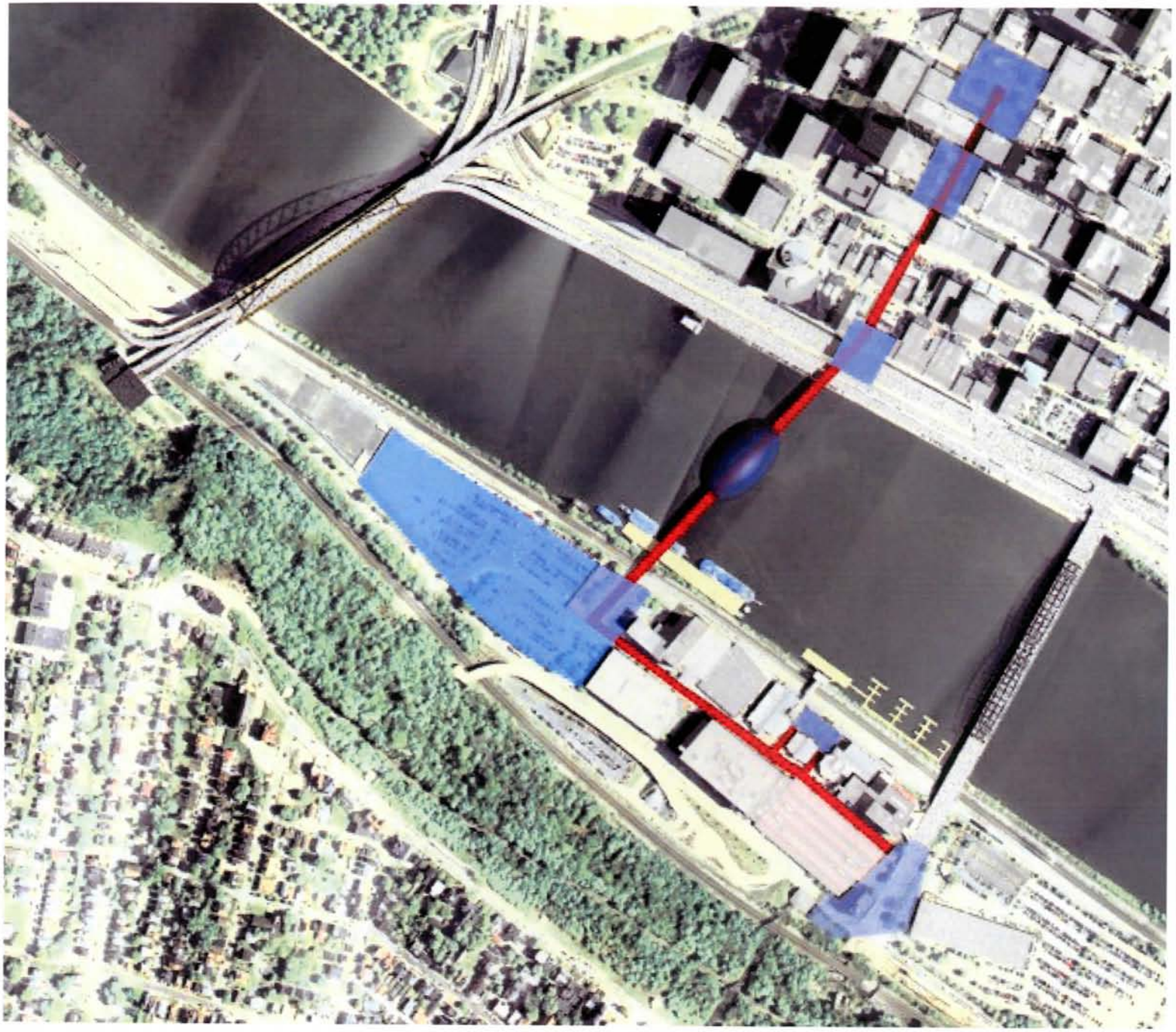
"The Port Authority Transit of Allegheny county (PAT) serves the city of Pittsburgh, all of Allegheny County and portions of five neighboring counties with 1,066 buses, 83 light rail vehicles, 4 incline cars, 75 other vehicles, and 457 ACCESS vehicles for elderly and handicapped riders. PAT services 228,454 passengers on an average weekday and had an approximate ridership of 68 million in 2004. There are 15,879 stops of which 256 are shelters or stations, and 64 Park and Ride lots with 14,850 parking spaces. Bus fare for adults is $1.75 for a one-way trip, and just 50 cents more buys one a transfer to a connecting line or a ride back home."

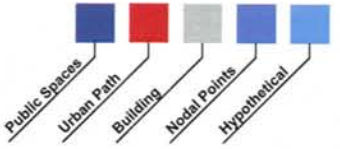
Daytime population change due to commuting: +138,191 (+41.3%)
Workers who live and work in this city: 98,005 (69.1%)
source: City-data.com

Historic map of Pittsburgh from the early 1900s. A large amount of land is devoted to infrastructire such as train tracks and bridges.
source: University of Pittsburgh, Darlington Digital Library

The evolution of a city can be seen here to a certain degree. A late 1800s rendering of Pittsburgh as compared to a photograph of the city in 1960, and and finally to an image of the skyline today

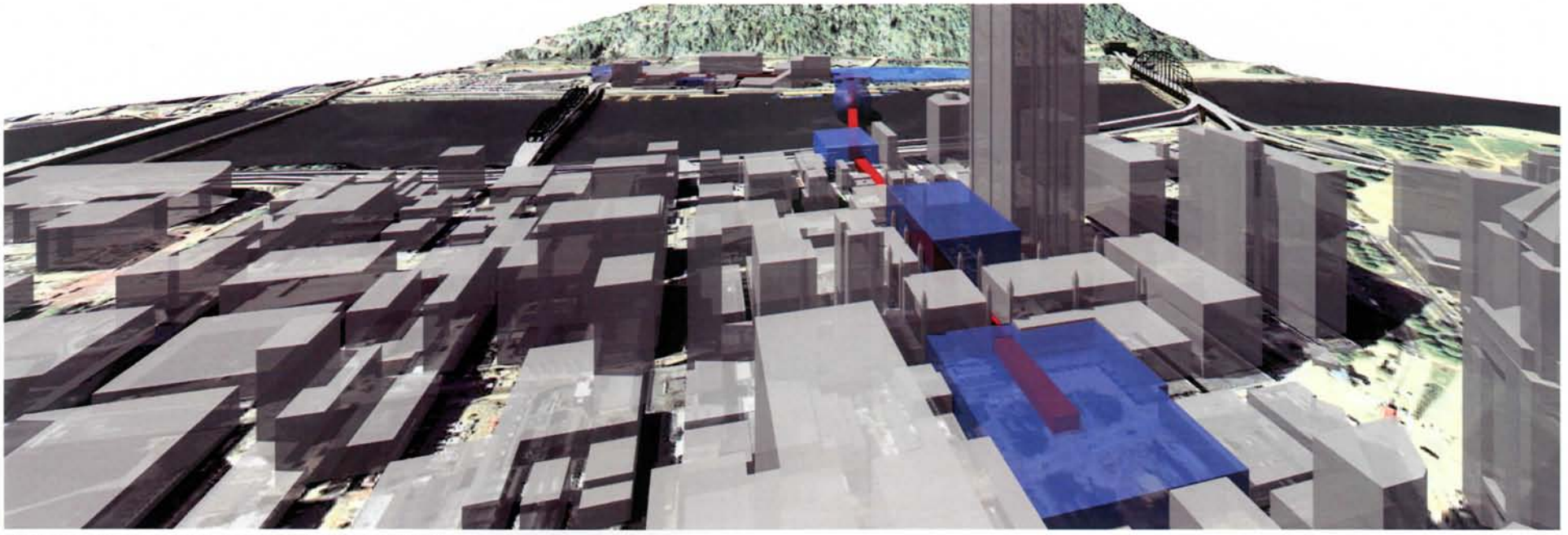
Pittsburgh's short history had it become the largest industrial producer of steel for a long time. This industrialization shaped the city into a hub of infrastructure of all kinds. Bridges for trains, molten lead, or trucks were constructed throughout the city. Factories and mills claimed land close to the waterfront so they could ship finished supplies easily. The city was bustling in the mid 1900s, but once the Rust-Belt Era began, the city had nothing else to fall back onto yet. Developments in technology, healthcare and other industries kept Pittsburgh afloat as it changed its image. The city shown in maps and period images like these is no more. In one regard a programmed bridge in modern day Pittsburgh would be an ideal way to acknowledge the city's industrial past.



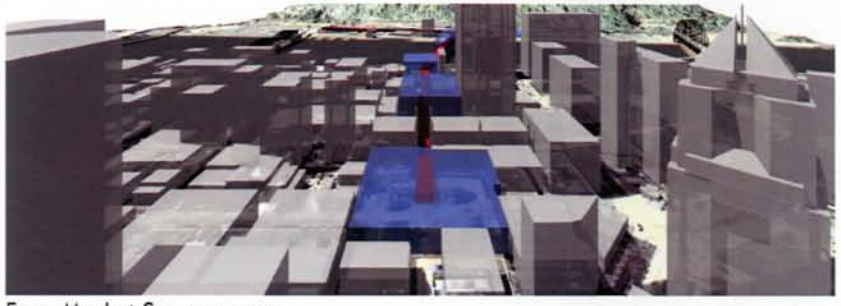


Aerial Rendering of Site:

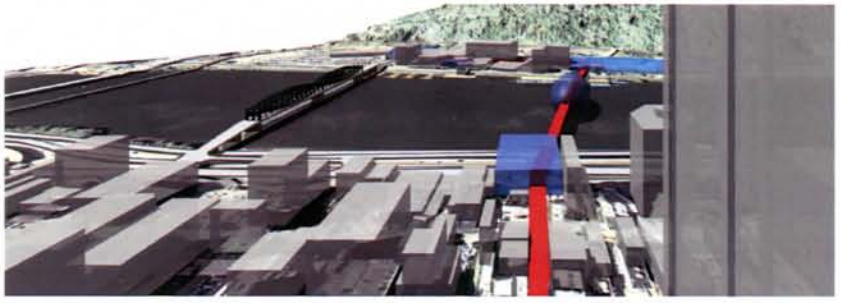
Highlights the entire urban sequence from Market Square as the northern-most space to Smithfield Street as the southeastern-most space. Includes existing public spaces/spaces with access to innfrastructure. Also connects two sides of the Monagahela River with an urban pathway, two proposed nodal points and a primary destination space over the river.



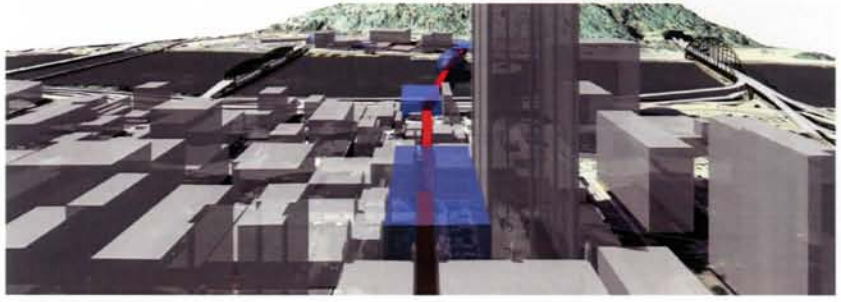
Overview of entire urban sequence looking southwest



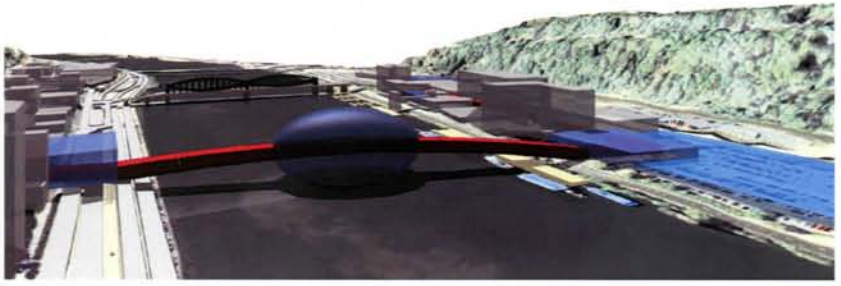
From Market Square space



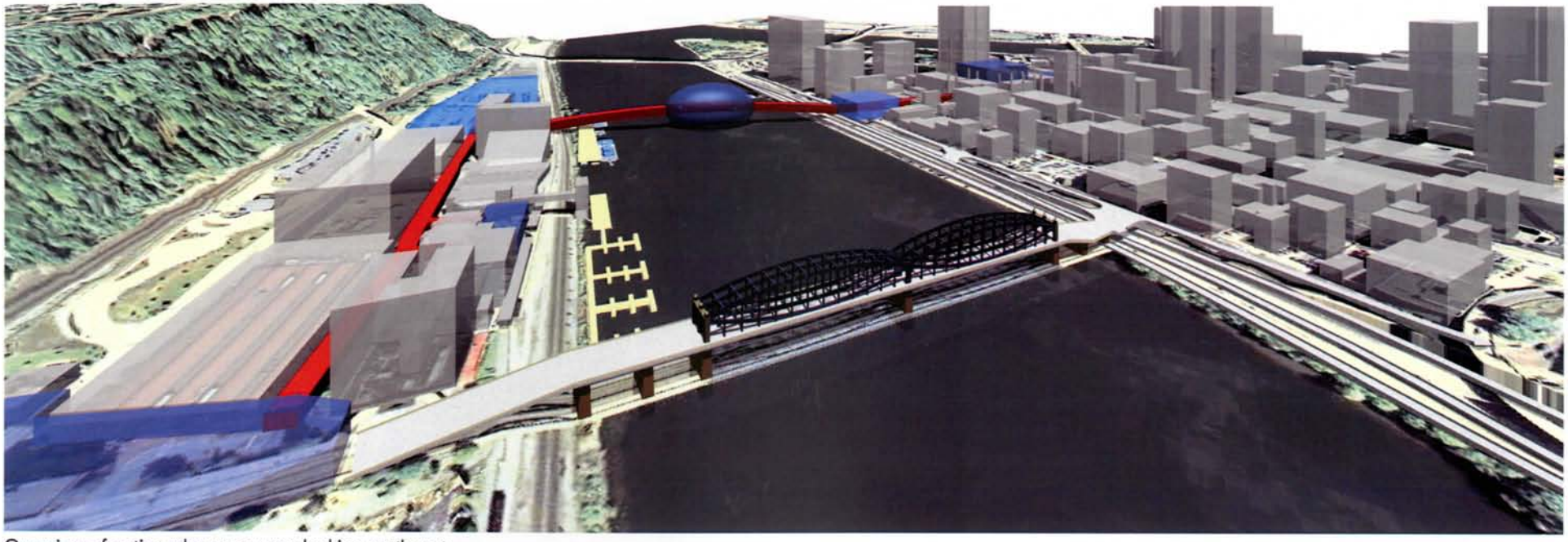
From Nodal Point Fort Pitt Boulevard



From PPG Plaza space

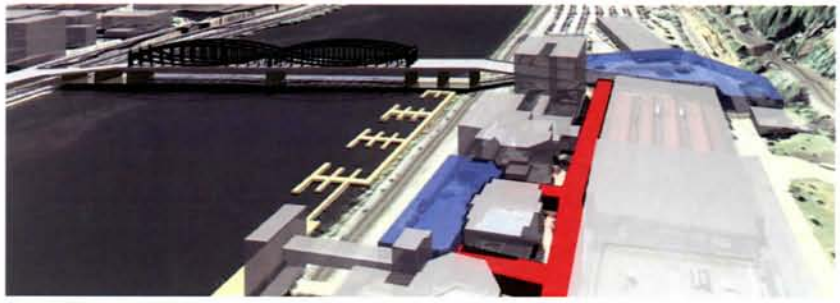


From over the Monagahela River viewing proposed design areas

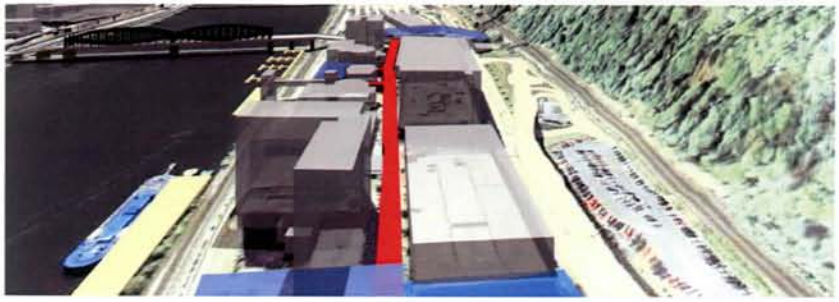


Overview of entire urban sequence looking northwest

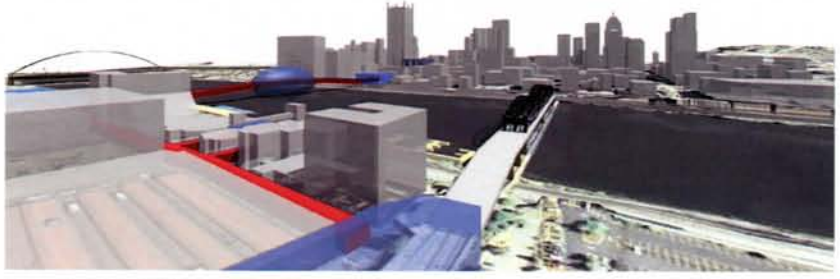
From Nodal Point Station Square Parking + additional space for development



From Bessemer Court space

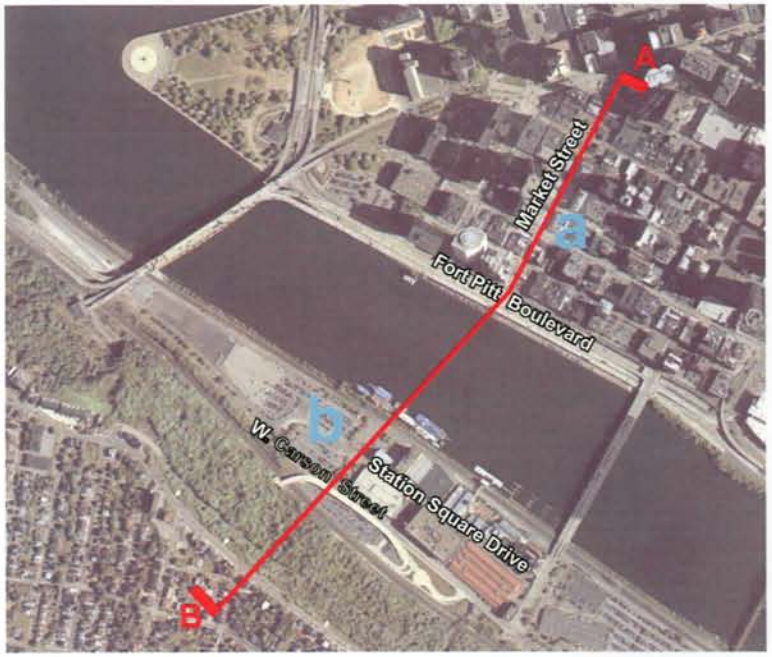


View down Station Square Drive



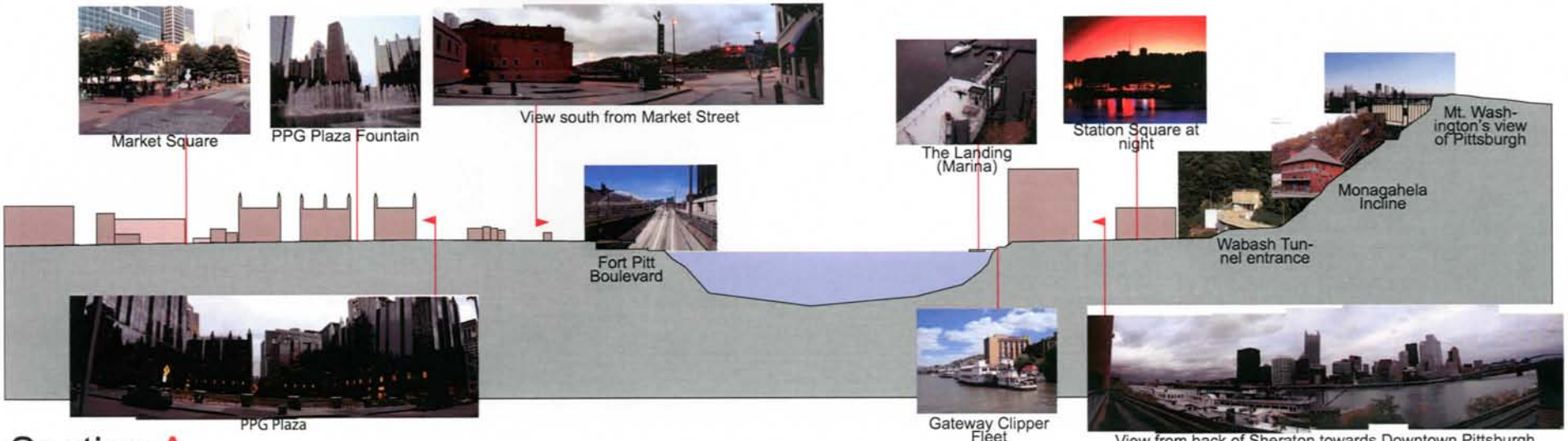
From Smithfield Street space

Site_ Section of Project Location Oriented Southeast



Aerial Photo of site:
Section Cuts, Destinations, and Primary Streets shown

This section is cut through the location of the proposed bridge project and extends in either direction into the existing spaces. It looks southeast.

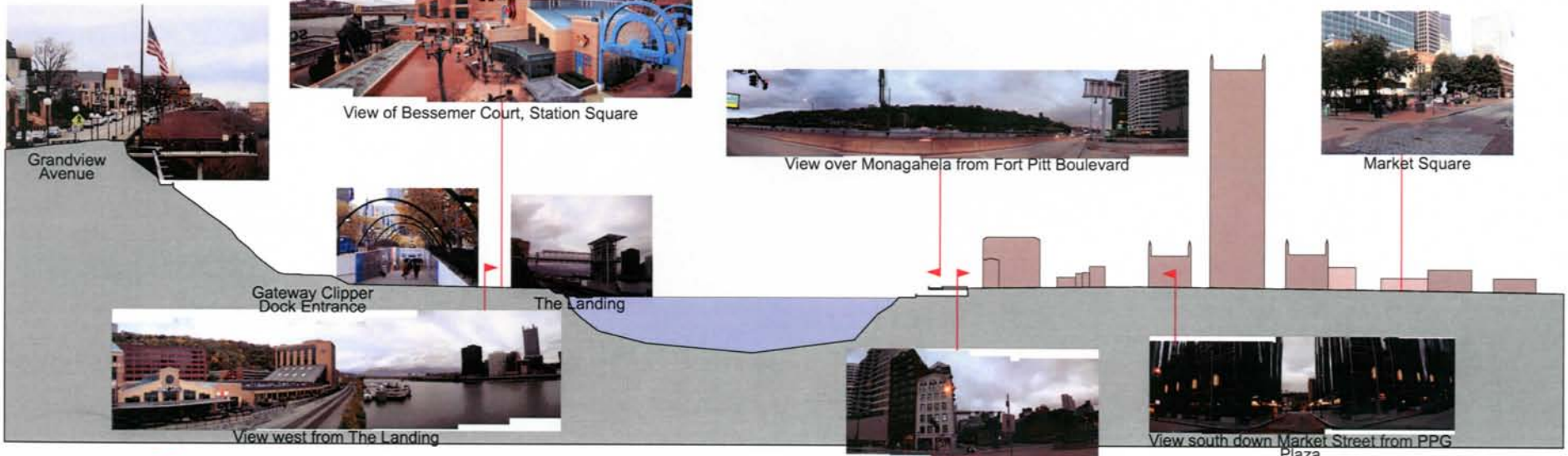


Section A

Site_Section of Project Location Oriented Northwest

Aerial Photo of site:
Section Cuts, Destinations,
and Primary Streets shown

This section is cut through the location of the proposed bridge project and extends in either direction into the existing spaces. It looks northwest.



Section B

View of Nodal Point from Market Street

Downtown
Business
Retail
Housing
Market Square
Culture
Retail
PPG Plaza
Culture
Retail

Infrastructure
Bike trail
Bus routes

1. Heinz Hall and Benedum Theater are destinations within the cultural district of Downtown Pittsburgh. PNC is also easily accessible from this point for Major League Baseball games and other events.

2. Market Square is designed after European piazzas. It fetaures brick paving, landscaping with trees and a temporary stage for events. Many eateries are located here, in a ddition to a few retail stores. The tradition of Market Square as Pittsburgh's first real 'piazza' makes it a strong destination point.

3. Point Park features large outdoor spaces at the apex of the city of Pittsburgh. Gateway Center is an office complex of buildings with a courtyard space within their confines. Heinz Field has Football games and other events throughout the year.

4. The 'T' stop accessible from here is the last, or first stop downtown.

5. These historical roads of Pittsburgh feature a long cultural and retail history. Smithfield Street and Forbes Avenue are shown here.

6. PPG Plaza is a complex of office buildings with a large 'piazza' in the center that is adjacent to Market Square - one of its intentions is to be a contemporary Market Square. There are many cultural events in this Plaza and the surrounding spaces of the PPG complex throughout the year, and high-end retail can be found here.

7. Point Park College, bus transportation into and out of downtown, and the Firstside area of Pittsburgh is reached from here. Point Park College spatially occupies a few blocks of downtown, and beyond the campus is the business district Firstside.

Destination A, or Anchor point A, is on the north side of the Monagahela River. Its immediate connection area to a proposed bridge is the intersection of Fort Pitt Boulevard and Market Street. Market Street reaches northeast into the heart of downtown Pittsburgh linking into existing retail, office, cultural, infrastructural and residential nodes. Two existing "piazzas" are along the artery - PPG Plaza and Market Square. Park space, concert halls and varied amenities such as banks and churches are all in close vicinity to the Market Street artery.

Station Square
Culture
Business
Retail
Hotel
Gateway Clipper
Fleet
Culture
Mt. Washington
Housing
Culture

Infrastructure
Bike trail
Bus routes
Monagahela Incline
Duquesne Incline
The 'T'
Gateway Clipper
Fleet

1. Chevorlet Amphi-theater
2. Gateway Clipper Fleet
3. The Landing
4. Bessemer Court, Station Square, Sheraton Hotel
5. Monagahela Incline, Mt. Washington, Light Transit Station
6. Restaraunt & Nightlife, Parking

View of Nodal Point from Wabash Tunnel Entrance

1. The Chevorlet Amphitheater regularly hold events such as concerts. It is generally a seasonal outdoor venue.

2. The Gateway Clipper Fleet offers service to events around Pittsburgh (including sporting events), as well as catering to private parties. It is the largest riverboat fleet in the United States. It is a strong source of cultural pride for the city.

3. The Landing at Station Square is a full service, seasonal and public marina. It allows easy access to all amenities Station Square has to offer.

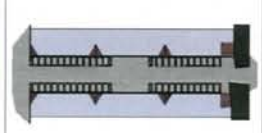
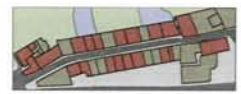
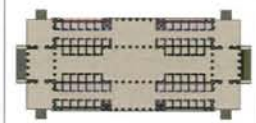
4. Station Square is an urban reuse retail and office project. It has become a cultural and entertainment center for the city with many forms of retail, restaurants and nightlife available. Bessemer Court is Station Square's newly renovated 'piazza'. It is a good gathering place for events. The Sheraton is the closest hotel to downtown Pitsburgh.

5. The Monagahela Incline is one of two in Pittsburgh. It allows easy public access to and from Mt. Washington (a neighborhood of the city). Mt. Washington is rich in culture and panorama along its Grandview Avenue. A light rail "T' station is also minutes away from the heart of Station Square.

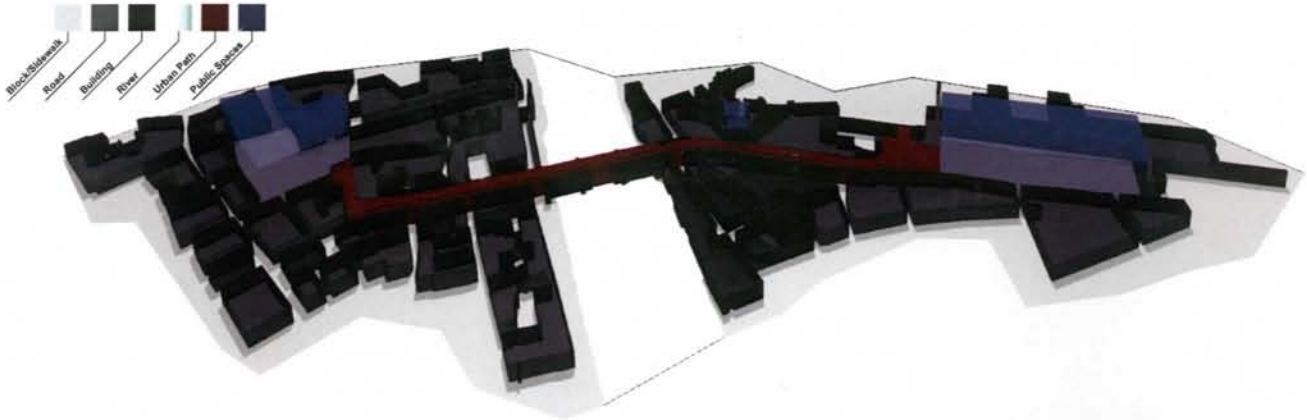
6. A center for young-adult life and event parking.

Destination B, or Anchor point B, is on the south side of the Monagahela River. Its immediate connection area to a proposed bridge is from a parking lot to the west of the Sheraton Hotel. Station Square is a revitalized culture and entertainment space with many restaraunts, stores, and offices. It has a large "piazza" in Bessemer Court. There is a public marina and a riverboat service found at this anchor point. It ties into the transportation infrastructure to outlying city districts, such as Mt. Washington, and the suburbs to the south of Pittsburgh.

Bridge Precendents [Traditional]

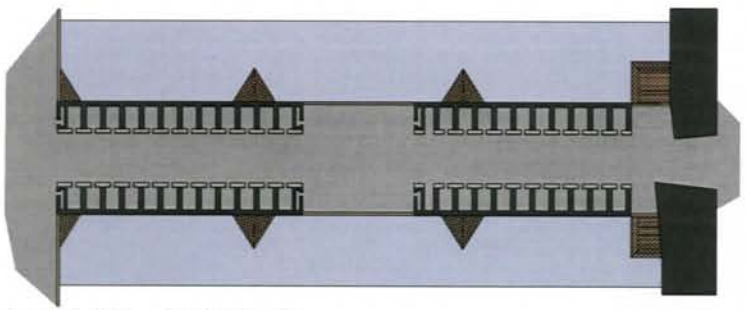
Information/Use	Image	Elevation/ Section	Plan	Site Plan	Urban Sequence	Program Parti
Ponte Vecchio Florence, Italy 1345 - rebuilt Tadeo Gaddi Housing, Retail Pedestrian traffic						
Krämerbrücke Erfurt, Germany 1472 - rebuilt Housing, Retail Pedestrian/Auto traffic						
Rialto Bridge Venice, Italy Andrea Palladio 1551 - unbuilt Retail Pedestrian traffic						
Rialto Bridge Venice, Italy Antonio de Ponte 1591 Retail Pedestrian traffic						
Pulteney Bridge Bath, England Robert Adam 1773 Housing, Retail Pedestrian traffic						

Throughout history there have been many examples of bridges constructed in Europe that routinely had program on it. Whether it was in Florence, Italy (Ponte Vecchio), London, England (London Bridge) or Paris, France (Pont Notre Dame) every culture has seen development of this typology mix. Many have been destroyed or deconstucted due to urban expansion and pragmatics of allowing traffic over the bridge. Their heritage continues today due to the ones that still exist like the Rialto Bridge in Venice, Italy that became a retail destination. In translating lessons from these historic precedents, a comprehensive understanding of why they were successful in their site and what they did for their immediate site's growth must be known.



Urban Sequence Diagram: Ponte Vecchio

Rendered Elevation: Ponte Vecchio



Rendered Plan: Ponte Vecchio

Program Diagram: Ponte Vecchio

Rendered Site Plan:
Ponte Vecchio

View of the Ponte Vecchio

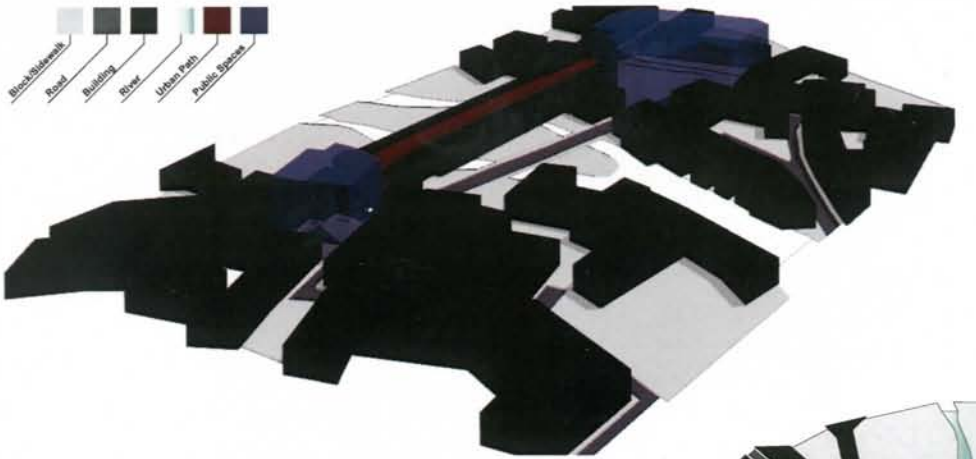
Ponte Vecchio
Florence, Italy
Tadeo Gaddi
1345 - rebuilt

Use: Housing, Retail, Pedestrian Traffic.

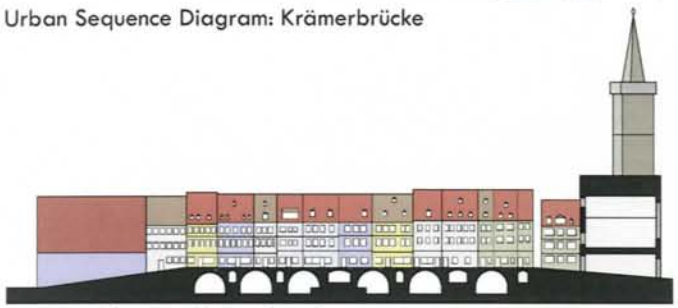
Present Day: It has always hosted shops and merchants who displayed their goods on tables before their premises. The back shops (retrobotteghe) that may be seen from upriver, were added in the seventeenth century.

Sequence: The Ponte Vecchio ties strongly into 3 piazzas: Piazza de' Pitti at the southern most point, the small Piazza di Sant Felicita, and Piazza della Signoria at the northern most point. It tradtionally tied together the governing palaces of Florence rule in the 14th Century. The piazzas are now primarily tourist destinations.

Programmed Bridge_Krämerbrücke

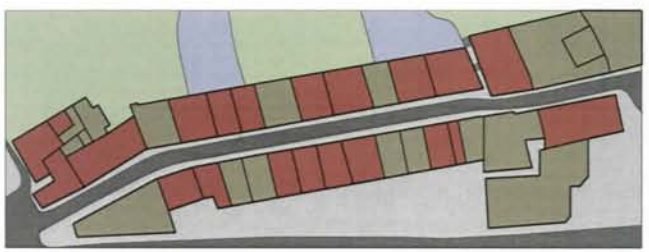


Urban Sequence Diagram: Krämerbrücke

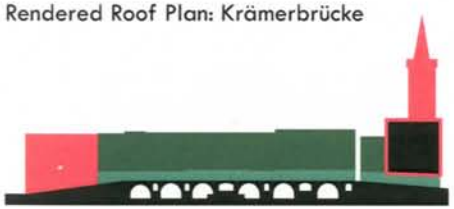


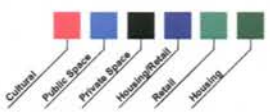
Rendered Section: Krämerbrücke

Rendered Site Plan:
Ponte Vecchio



Rendered Roof Plan: Krämerbrücke





Program Diagram: Krämerbrücke

View of the Krämerbrücke

Krämerbrücke
Erfurt, Germany
1472 - rebuilt

Use: Housing, Retail, Pedestrian/Auto Traffic.

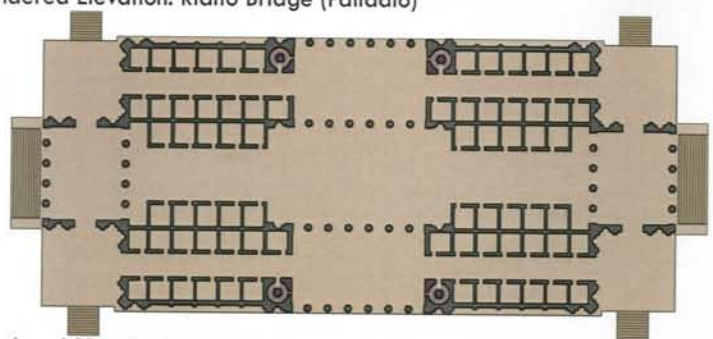
Present Day: Currently mostly artisans' and antique shops can be found in the 32 houses on Krämerbrücke. Except for the houses numbers 15, 20, 24 and 33, all houses are municipal property. The greatest city festival of Erfurt is named after the bridge: "Krämerbrückenfest". It is held around the bridge and in the old town annually in June.

Sequence: Krämerbrücke links two places: Benediktsplatz to the west and the larger Wenigemarkt Square to the east. In the past they were spaces for merchants to sell their goods, and in present day they still are mainly retail and service orientated places.

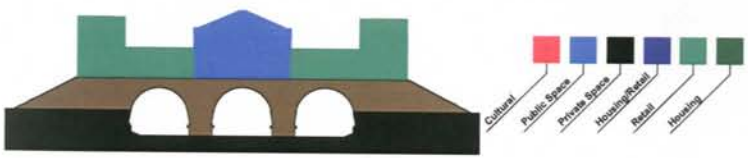
Programmed Bridge_ Rialto Bridge (Palladio)

Urban Sequence Diagram: Ponte Vecchio

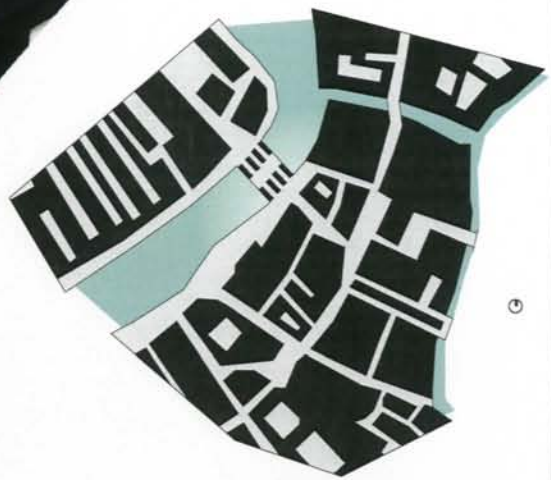
Rendered Elevation: Rialto Bridge (Palladio)



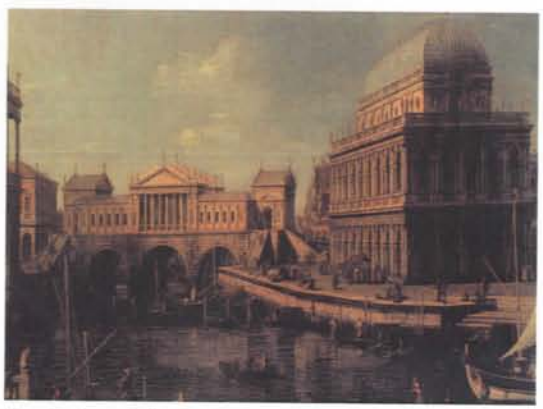
Rendered Plan: Rialto Bridge (Palladio)



Program Diagram: Rialto Bridge (Palladio)



Rendered Site Plan:
Rialto Bridge (Palladio)



Rendering of the Rialto Bridge (Palladio)

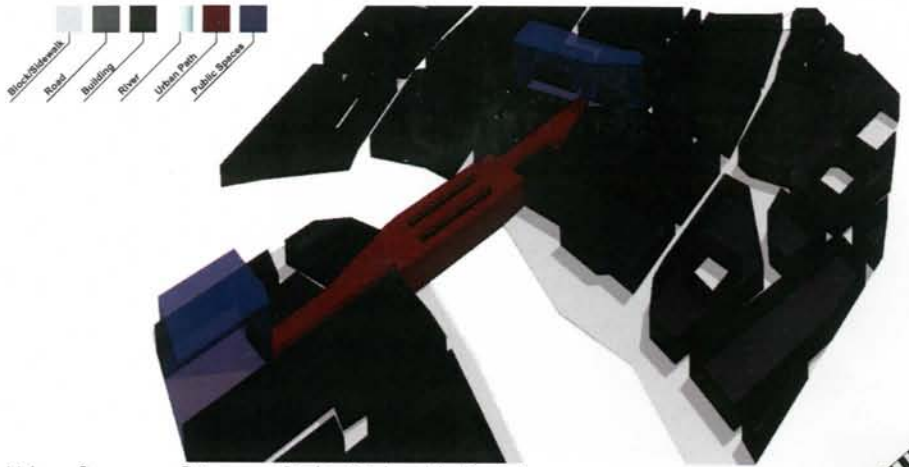
Rialto Bridge
Venice, Italy
Andrea Palladio
1551 - unbuilt

Use: Housing, Retail, Pedestrian Traffic.

Present Day: Palladio's Riallto Bridge design involved a Classical approach with several arches, which was judged inappropriate to the situation.

Sequence: The Palladian Rialto Bridge creates a programmed link between the Mercato of Venice to the northwest and the sliver of space known as the Campo San Bartolomeo to the southeast. The Mercato was in past centuries the merchant capital of Western Europe. It now houses the fish market and tourist retail. The Campo was home to the city's Germans, and now hosts many bars and restaurants.

Programmed Bridge_ Rialto Bridge (de Ponte)

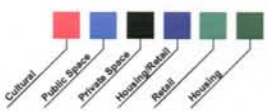


Urban Sequence Diagram: Rialto Bridge (de Ponte)

Rendered Elevation: Rialto Bridge (de Ponte)

Rendered Site Plan:
Rialto Bridge (de Ponte)

Program Diagram: Rialto Bridge (de Ponte)



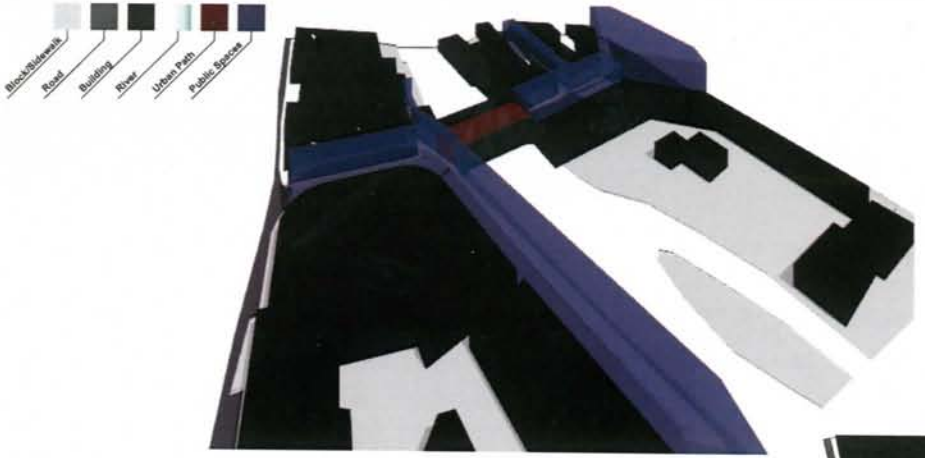
View of the Rialto Bridge (de Ponte)

Rialto Bridge
Venice, Italy
Antonio de Ponte
1591

Use: Retail, Pedestrian Traffic.
Present Day: Two inclined ramps lead up to a central portico. On either side of the portico the covered ramps carry rows of shops. Today, shop stalls line both sides of the bridge and it has become one of the major tourist sights in Venice.

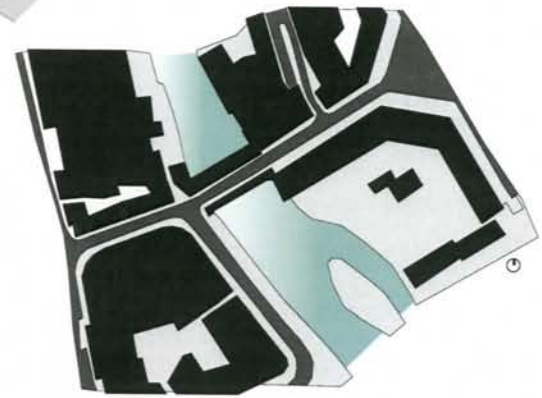
Sequence: The Rialto Bridge creates a programmed link between the Mercato of Venice to the northwest and the sliver of space known as the Campo San Bartolomeo to the southeast. The Mercato was in past centuries the merchant capital of Western Europe. It now houses the fish market and tourist retail. The Campo was home to the city's Germans, and now hosts many bars and restaurants.

Programmed Bridge_ Pulteney Bridge

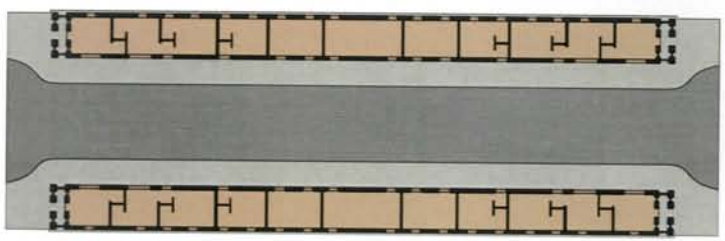


Urban Sequence Diagram: Pulteney Bridge

Rendered Section: Pulteney Bridge



Rendered Site Plan: Pulteney Bridge



Rendered Plan: Pulteney Bridge

Program Diagram: Pulteney Bridge

View of the Pulteney Bridge

Pulteney Bridge
Bath, England
Robert Adam
1773

Use: Housing, Retail, Pedestrian Traffic.

Present Day: As a continuation of New Bond Street, the bridge attracts shoppers and diners to the tiny retail establishments overlooking the water.

Sequence: The Pulteney Bridge was planned to spur urban growth on the west side of the River Avon by creating a new town to be a suburb to historic Bath, England. A new housing development erupted from the placement of the Pulteney Bridge called Laura Place. Parks (Parade Gardens) and other programmed spaces link into the the west side of the bridge.

London Bridge 800 Competition
London, England
Lawrence Friesen
2009 (unbuilt)

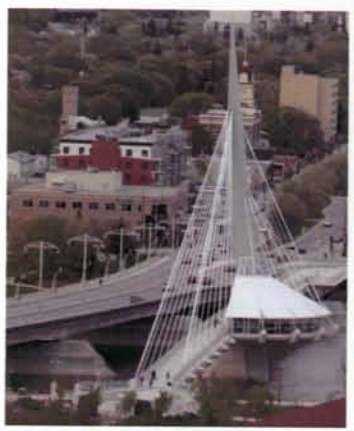
London Bridge 800 Competition
London, England
Ryszard Rychlicki
2009 (unbuilt)

Heavy/Light House
Plattsburg, NY
Dan Hisel
2009 (unbuilt)

Habitable Bridge Competition
London, England
Krier Kohl
1995 (unbuilt)

LM Harbor Gateway
Copenhagen, Denmark
Steven Holl
2008 (unbuilt)

The Accommodating Structure
New York, NY
Marc Mimram
2008 (unbuilt)

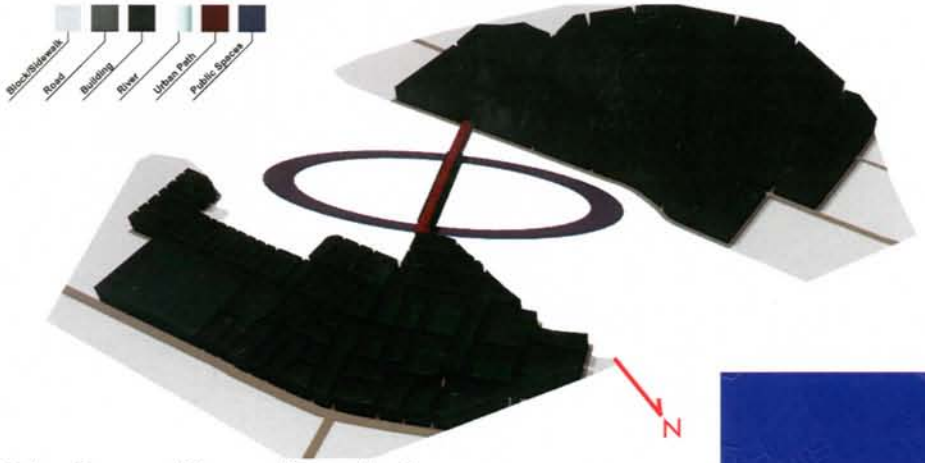


Esplanade Riel
Winnipeg, Manitoba
Colin Douglas Stewart
2003

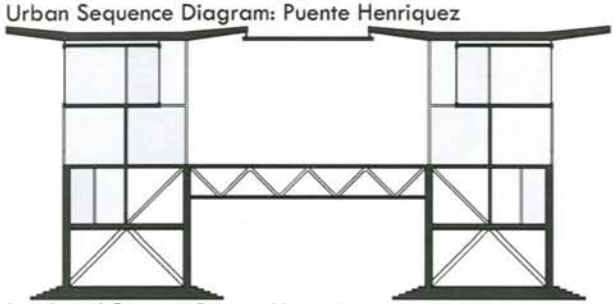
Motorway bridge and control center
Nanterre, France
ODBC
1996

In the past few decades there have been many proposals for programming a bridge all around the world. A competition In London in 1995 and 2009 for a bridge to cross the Thames River spawned many unique solutions including the Millenium Bridge. Isolated bridge designs from Hadi Teherani, Michael Graves and other architects/engineers around the globe also continue the dialogue on the validity of a contemporary inhabited bridge. With a serious proposal in Hamburg, Germany the realization of a large bridge with program being built on it is more realistic in the near future. These designs draw inspiration from bridges of old and modernize them with new technologies and design ideals. They use the bridges in some cases as activators - they are not just an object, but also create development and change. Understanding these designers' motives and their historic interpretation of the world's Ponte Vecchio's will influence the design process. This array of bridges show the variety of built and unbuilt programmed bridge designs around the globe.

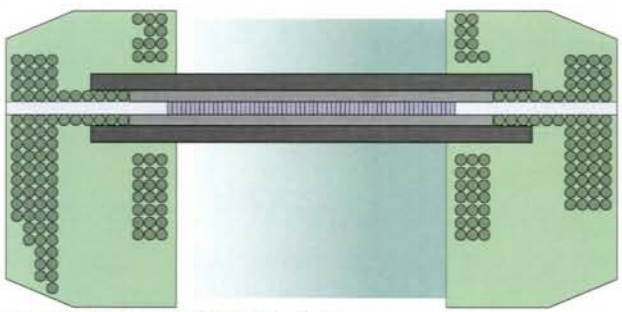
Programmed Bridge_ Puente Henriquez



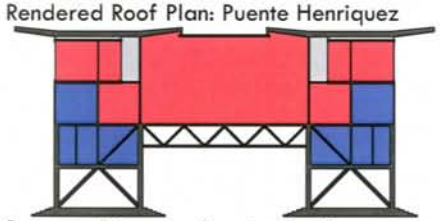
Urban Sequence Diagram: Puente Henriquez



Rendered Section: Puente Henriquez



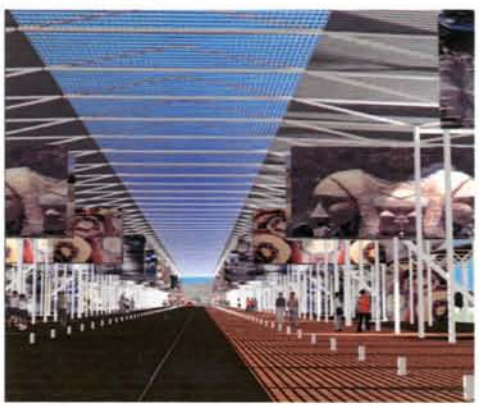
Rendered Roof Plan: Puente Henriquez



Program Diagram: Puente Henriquez

Rendered Site Plan: Puente Henriquez

source: Samyn & Partners



Rendering of the Punete Henriquez

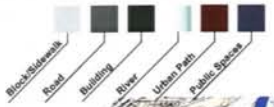
source: Samyn & Partners

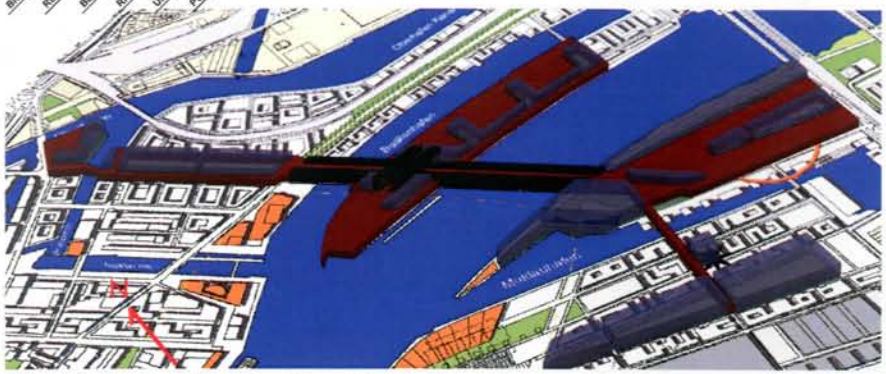
Puente Henriquez
Copiapo, Chile
Samyn & Partners
2009 - unbuilt

Use: Retail, Pedestrian Traffic.

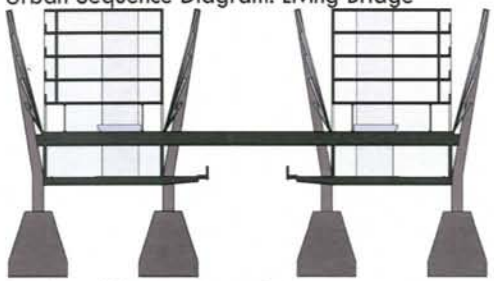
Design Ideal(s): The Henriquez bridge is the head project of a lare-scale urban landscaping intervention in Copiapo. It is the proposed linking element between the two banks of the city which currently has no permanent link. The bridge is in perfect alignment with either sides' major arteries. It is at once a bridge, a building and a square.

Sequence: An artificial lake is also part of the Puente Henriquez's urban design scope. It is meant to clarify what is river, bridge, land or building - The Copiapo River floods regularly (the banks can change between 20-200 meters) - therefore it distorts these distinct areas. The bridge is meant to spur the economic groth on the southern bank too.

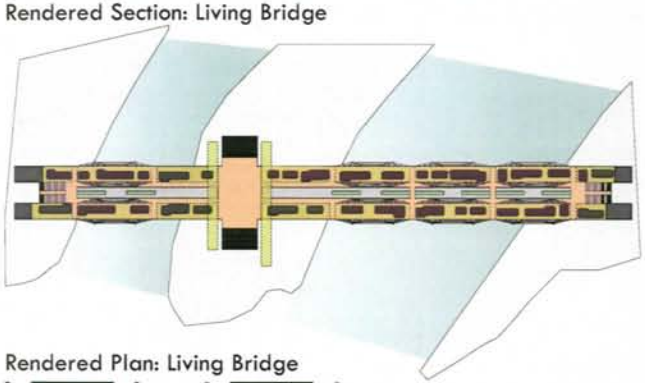




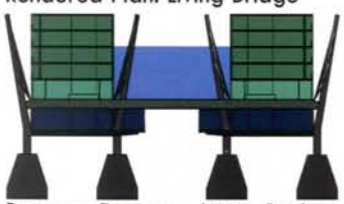
Urban Sequence Diagram: Living Bridge



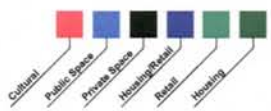
Rendered Section: Living Bridge

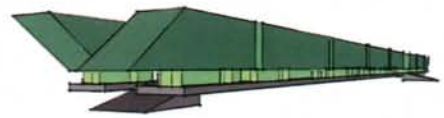


Rendered Plan: Living Bridge



Program Diagram: Living Bridge





Parti Program Distribution:
Living Bridge

Rendered Site Plan: Living Bridge

source: BRT

Rendering of the Living Bridge central path

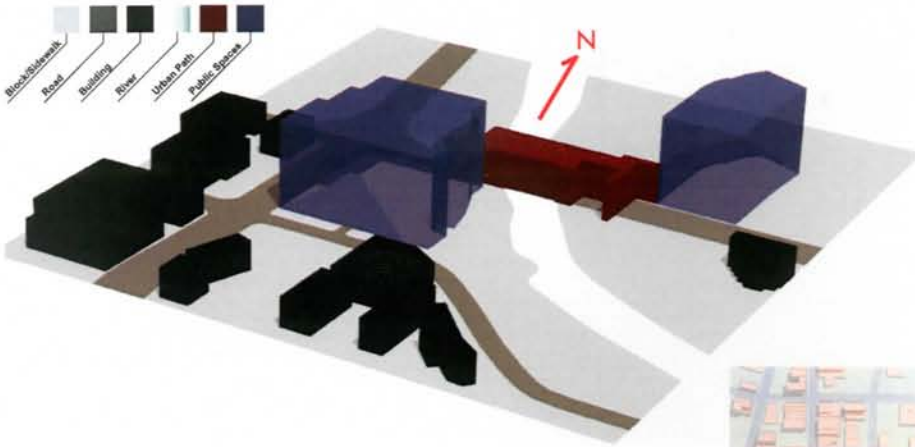
source: BRT

Living Bridge
Hamburg, Germany
Hadi Teherani
2009 - unbuilt

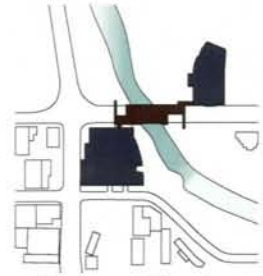
Use: Housing, Retail, Office space, Pedestrian/Auto traffic

Design Ideal(s): It is not just an infrastructural bridge but also an inhabited, lively city. That entails: panoramic views; the dense atmosphere of a greened urban pedestrian zone; numerous cultural offerings, tourist sights and thousands of affordable apartments right in the heart of Hamburg.

Sequence: The Living Bridge over the Elbe River could spark urban growth in the northern Grasbrook District where the old port has suffered from poor planning. Much is planned for the redevelopment of the northern part of Hamburg which the Living Bridge links into very well from the old city's infrastructure to the south to the new works to the north.



Urban Sequence Diagram: Fargo & Moorhead Cultural Center Bridge



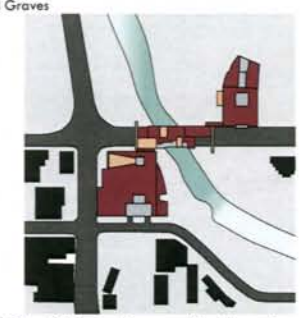
Urban Sequence Plan: Fargo & Moorhead Cultural Center Bridge

Rendered Elevation: Fargo & Moorhead Cultural Center Bridge

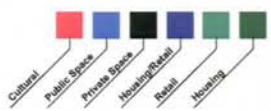
source: Michael Graves

Modeled Site Plan: Fargo & Moorhead Cultural Center Bridge

source: Michael Graves



Rendered Roof Plan: Fargo & Moorhead Cultural Center Bridge



Program Diagram: Fargo & Moorhead Cultural Center Bridge

Model of the Fargo & Moorhead Cultural Center Bridge

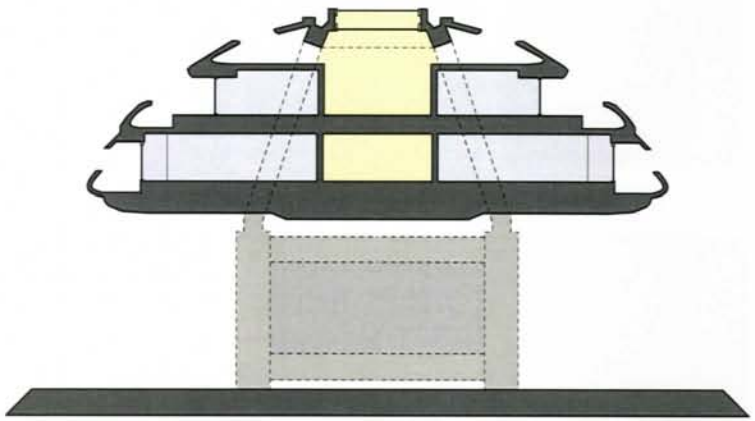
source: Michael Graves

Fargo & Moorhead Cultural Center Bridge
Fargo/Moorhead, North Dakota/Minnesota
Michael Graves
1977

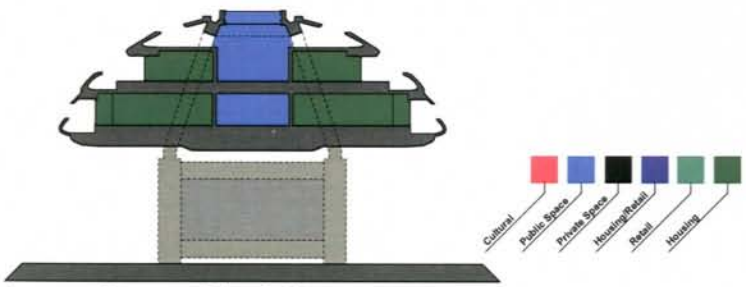
Use: Retail, Pedestrian Traffic.
Design Ideal(s): An art museum formed the actual bridge which links a concert hall, television and radio stations with a history museum. Graves describes the overall composition as an attempt at vertical unity where the river is the basement story, the vehicular access and first level bridge are the piano nobile, and the art museum is the attic.

The concert hall/history museum act as destination points and not as nodal points. It is a flip on the concept of creating an object (art museum) and using its 'nodal points' (concert hall/history museum) as development tendrils.

View of Western Elevation: Glass Bridge



Rendered Section: Glass Bridge



Program Diagram: Glass Bridge

View of Model: Glass Bridge

Glass Bridge
London, England
Richard Horden Associates
1996 - unbuilt

Use: Housing, Retail, Pedestrian traffic

Design Ideal(s): It is a glazed structure that conveys a sense of lightness and grace. The Glass Bridge has a central conservatory that creates a good vantage-point for views up and down the river. It is inspired by the galleries in Europe.

The sustainable approach to this programmed bridge is important to note: a solar-powered shuttle bus links the north and south banks and it draws its energy from wind and solar cells and tidal changes.

Urban Sequence Diagram: Bay Line Bridge

source: Rael San Fratello


1


2


3

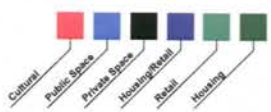

4


5


6

Sectional Perspectives: 1.) Row houses + gardens 2.) Live / work lofts + orchards 3.) Bungalow house + tennis courts 4.) Dormitories + climbing wall 5.) Condos + swimming pool 6.) Hotel rooms + outdoor amphitheater

source: Rael San Fratello



Program Diagram: Bay Line Bridge

Site Map: Bay Line Bridge

source: Rael San Fratello

Parti: Bay Line Bridge

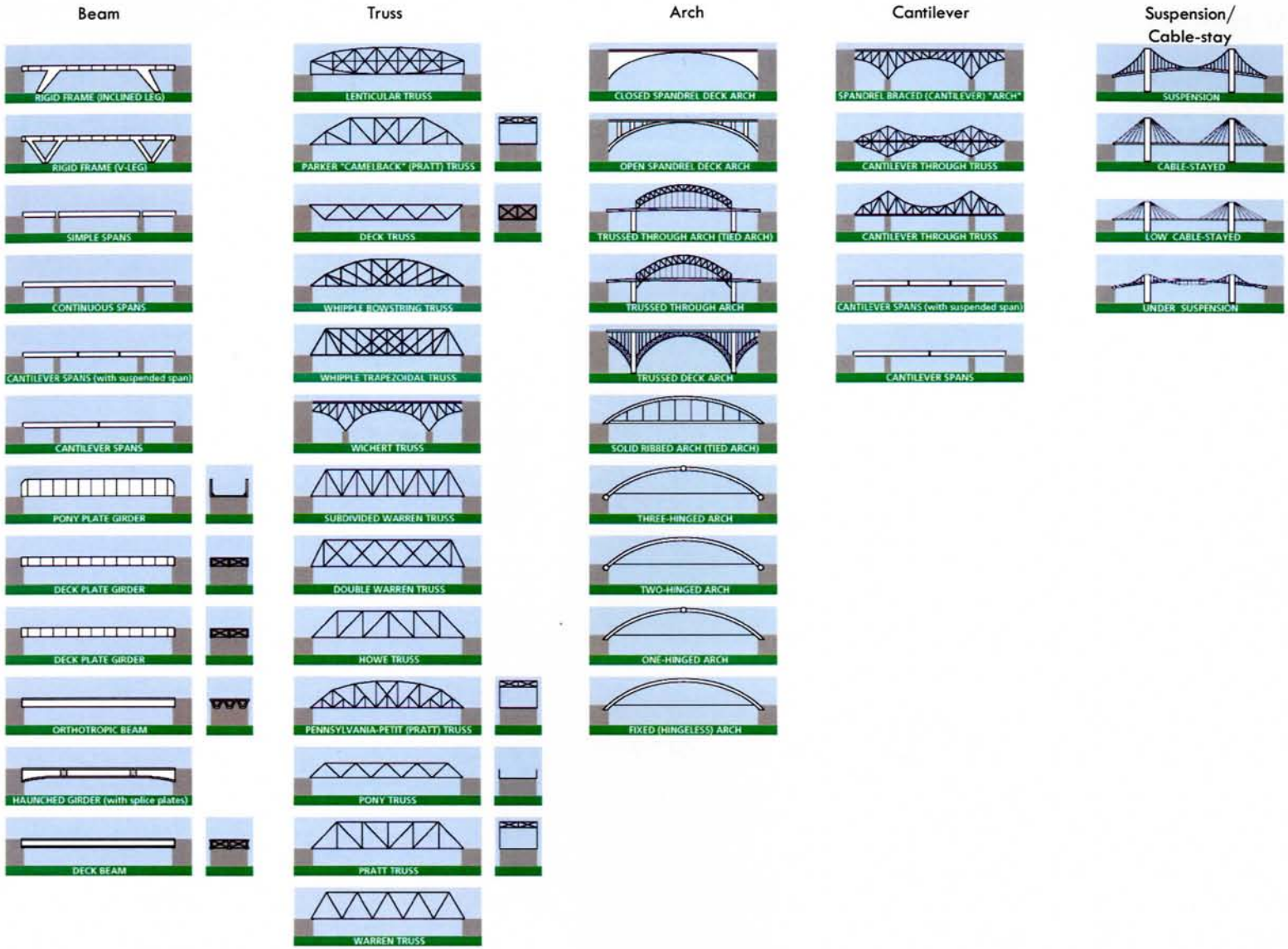
Bay Line Bridge
San Francisco, CA
Rael San Fratello
Architects
2009 - unbuilt

Use: Housing, Recreation, Reuse, Pedestrian traffic

Design Ideal(s): This proposal seeks to demonstrate the potential for re-purposing bridge infrastructure as possible sites for urban housing and linear parks. Housing, recreational and cultural facilities connected with a continuous, green strip, floating above the water – an aerial garden.

The sheer diversity of program combination in the Bay Line Bridge Proposal - dorms & climbing walls, hotel & outdoor amphitheater - makes it a good source of information. These program combinations are on an existing bridge, but the scale and program types are similar to this project proposal so that it can be utilized.

Bridge_Types



source: pghbridges.com

Beam Bridge: This is the simplest kind of bridge. They are horizontal beams supported at each end by piers.

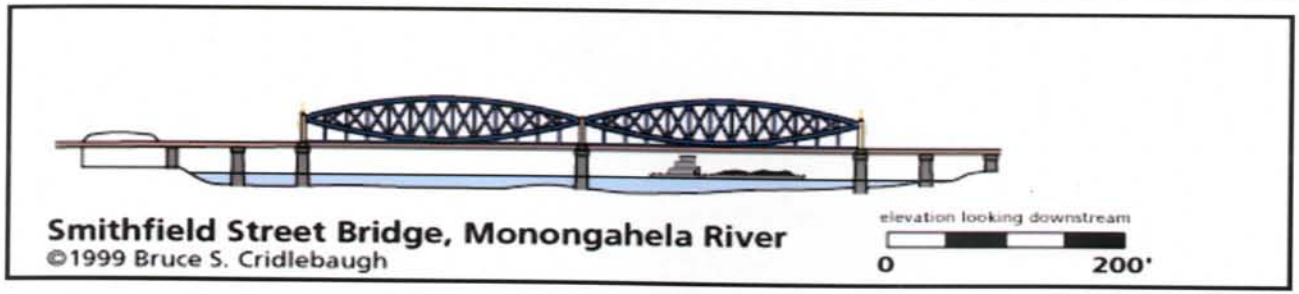
Truss Bridge: These are composed of connected elements. They have a solid deck and a lattice of pin-jointed or gusset-joined girders for the sides.

Arch Bridge: These are arch-shaped and have abutments at each end.

Cantilever Bridge: These are built using cantilevered horizontal beams which are supported on only one end. Most of these use two cantilever arms which extend out from opposite sides of the crossing to meet in the middle.

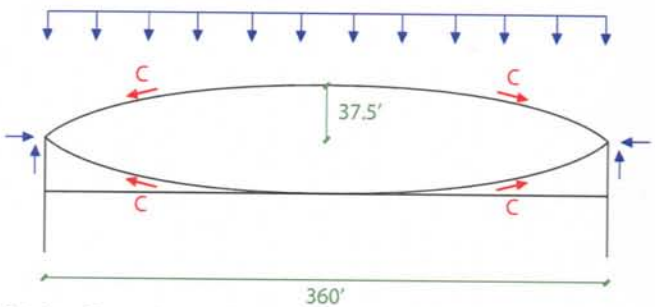
Suspension Bridge: These are suspended from cables that are attached to towers that are attached to caissons.

Cable-Stay Bridge: Same as suspension bridges, but less cable is needed and the towers are proportionally shorter.



Rendered Elevation: Smithfield Street Bridge

Structural Analysis



Bridge Type: Lenticular Truss
Span Length (l): 360'
Vertical Rise (d): 37.5'

Typical Ratio for $\frac{l}{d} : \frac{1}{7} - \frac{1}{12}$

Fort Pitt Bridge Ratio: $\frac{1}{9.8}$

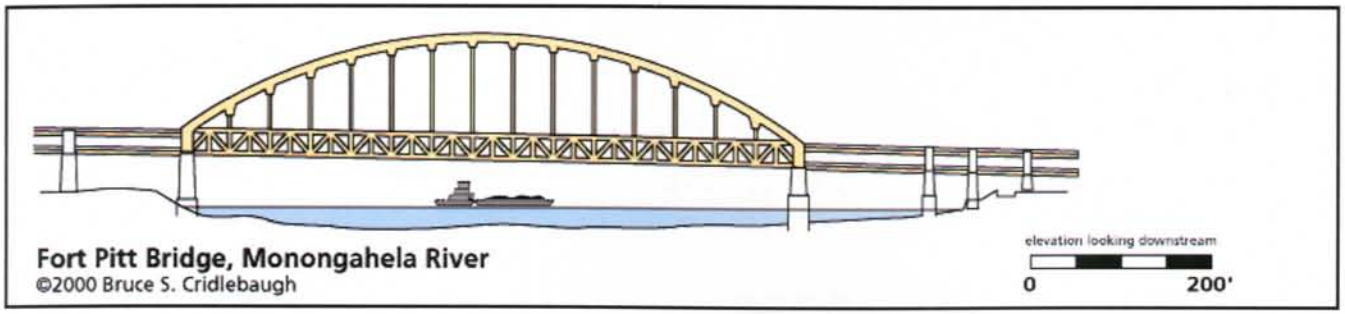
Total Distance Crossed: 1,184'

View of Smithfield Street Bridge at Night - Symbol of the City

Site Map: Smithefield Street Bridge Placement

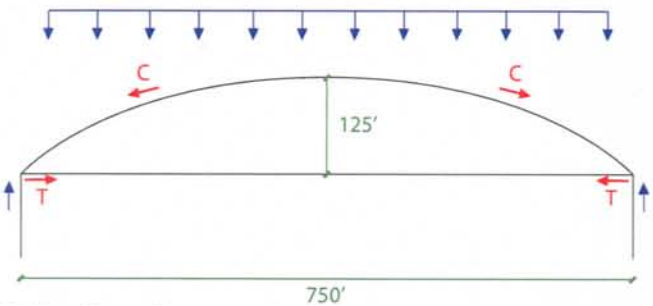
National Bridge Inventory Data:

Location: Smithfield St. Bridge (Lat: 40.433333, Lng: -80.003333)
Route carried "on" structure: State highway
Status: Posted for load
Average Daily Traffic: 12,802 (year 2008)
Design Load: H 15
Features Intersected: Monagahela River, CSX RR
Facility Carried by Structure: Smithfield St.
Lanes on structure: 3
Navigation Control: Yes (Vertical Clearance: 12.2m (40.0ft),Horizontal Clearance: 103.6m (339.9ft))
Material/Design: Steel
Design/Construction: Truss - Thru
Length of main span: 2 main Spans, 360 ft each (344 ft clear)
Total Length: 1,184 ft
Length of Maximum Span: 109.7m (359.9ft)
Curb or Sidewalk Widths: Left: 3.3m (10.8ft)
Right: 3.2m (10.5ft)
Curb-To-Curb Width: 12.8m (42.0ft)
Out-to-Out Width: 14.1m (46.3ft)
Operating Rating: 26.3 metric tons
Inventory Rating: 20.0 metric tons
Deck Structure Type: Closed Grating
Wearing Surface/Protective System:
Wearing Surface: Epoxy Overlay



Rendered Elevation: Fort Pitt Bridge

Structural Analysis

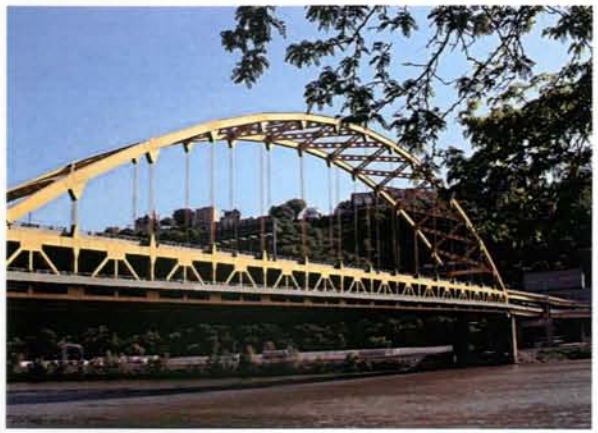


Bridge Type: Bowstring Arch
Span Length (l): 750'
Vertical Rise (d): 125'

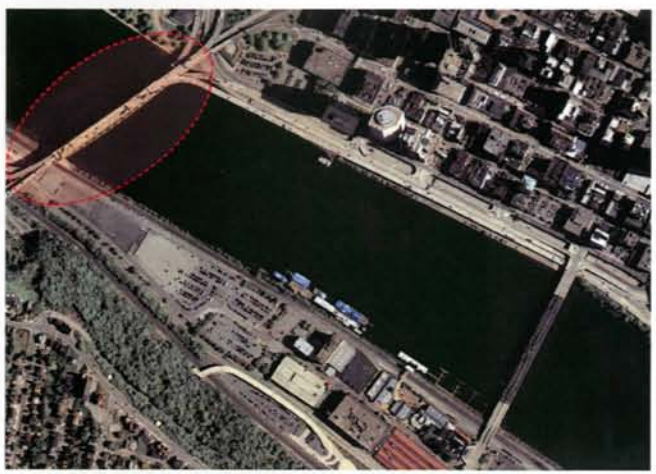
Typical Ratio for $\frac{l}{d} : \frac{1}{7} - \frac{1}{12}$

Fort Pitt Bridge Ratio: $\frac{1}{6}$

Total Distance Crossed: 1,207'



View of Fort Pitt Bridge - Key Infrastructure for the City



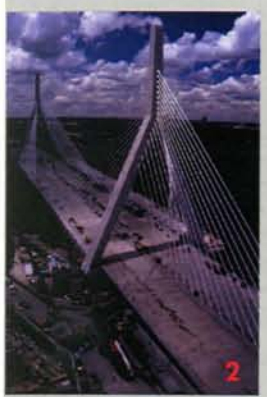
Site Map: Fort Pitt Bridge Placement

National Bridge Inventory Data:

Location: Fort Pitt Bridge (Lat: 40.437389, Lng: -80.013803)
Route carried "on" structure: Interstate 279
Status: Open
Average Daily Traffic: 70,147 (year 2008)
Design Load: H 15
Features Intersected: Monagahela River, P&LE RR, LR 376 Exits/Approaches
Facility Carried by Structure: Fort Pitt Bridge
Lanes on top-deck structure: 4
Lanes on bottom-deck structure: 4
Navigation Control: Yes (Vertical Clearance: 14.3m (46.9ft), Horizontal Clearance: 195.1m (640.1ft))
Material/Design: Steel
Design/Construction: Arch - Thru
Length of main span: 1 main span, 750 ft
Total length: 1,207 ft
Length of Maximum Span: 229.2m (752.0ft)
Curb or Sidewalk Widths: Left: 0.6m (2.0ft), Right: 0.6m (2.0ft)
Curb-To-Curb Width: 16.7m (54.8ft)
Out-to-Out Width: 17.8m (58.4ft)
Operating Rating: 68.0 metric tons
Inventory Rating: 40.8 metric tons
Deck Structure Type: Concrete Cast-file-Place
Wearing Surface/Protective System: Wearing Surface: Monolithic Concrete, Bituminous
Deck Protection: Epoxy Coated Reinforcing





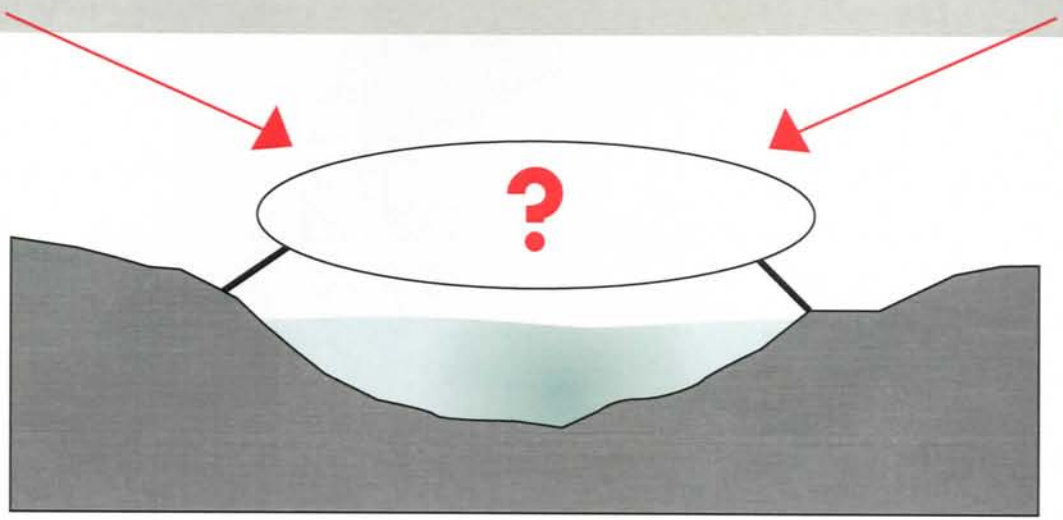





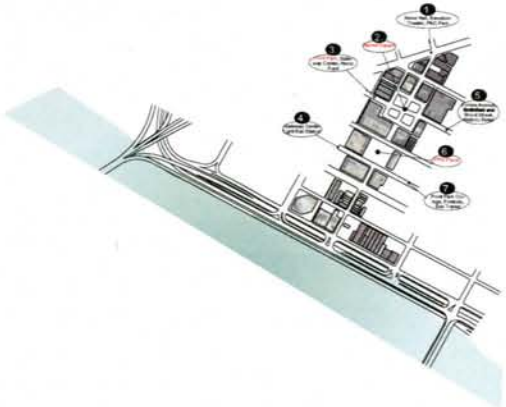




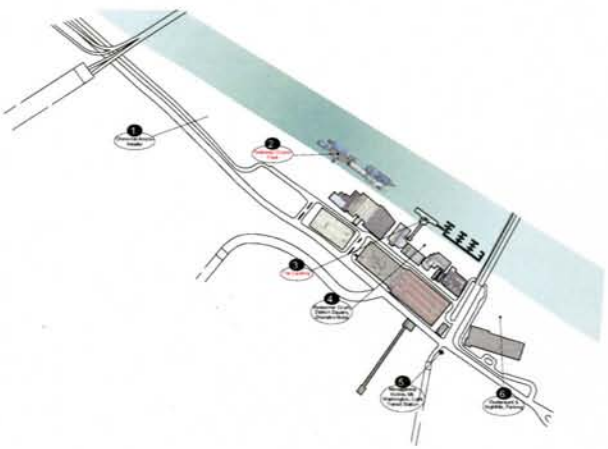
Structural solutions and design opportunities are something these 14 bridges exemplify. Finding a way to translate these unique designs to incorporate program is a challenge inherent in combining distinctly different typologies.

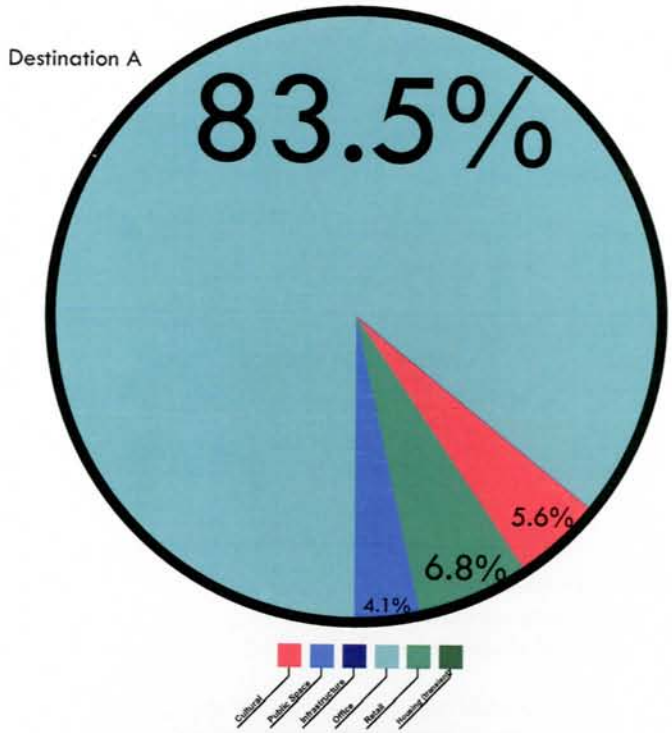


1. Infinity Bridge
2. Zakim Bunker Hill Bridge
3. Solferino Bridge
4. Yamuna Bridge
5. Sunniberg Bridge
6. Luscher's Geneva Bridge
7. Metro West Bridge
8. David L. Lawrence Convention Center
9. Sydney Harbor Bridge
10. Knokke Bridge
11. Arup's Living Bridge
12. Greenside Place Bridge
13. Golden Gate Bridge
14. Bridge over the Meuse



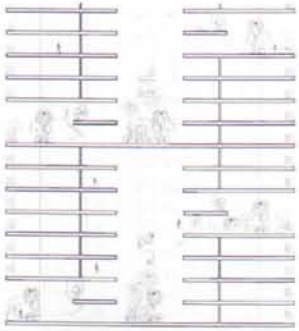
This program percentage analysis is of the buildings/spaces along the urban sequence in question. It divides either side of the proposed inhabited bridge - the two destinations - and highlights certain programmatic needs. New types of program could help create a balance between retail, public and cultural spaces. Besides the transient housing of a hotel, there is no housing located along the sequence in question. Office space takes up a large chunk of program on either side of the Monagahela, but that only insinuates that new office space is unneccesary. Public/outdoor space, is integral to the site selection, but overall does not have a large share of total real estate.





There are many precedents for a programmed bridge - whether built or unbuilt - and they lay a good foundation for how this typology mix may be designed. But this proposed bridge with program must have specific constraints for the types of program attached to it. In relation to the specific site and the city of Pittsburgh as a whole, an opportunity for mixed-use program on the bridge presents itself. Housing in the downtown area is scarce, and residents of the city do not stay in Pittsburgh beyond the work-day. With an addition of other program types (retail, office, cultural, etc.) a proposed bridge may become activated as a link, a piece of pedestrian infrastructure and a destination point.

Program_Types



Duxton Plain Urban Housing
Competition
Singapore
Santos Prescott & Associates
2002

Urban housing can be on a grand scale, like this project, or much smaller.

Mega Retail

Specialty Retail

Mom & Pop Stores

Differences in retail size, products, and ownership are all relevant

Bar

Restaurant

Service industries help to make an inhabitant of an area feel at home.

From large offices, to small scale and onto service-related like a doctor's office, all scales of office program can complement the overall mixed-use project.

Large programmed areas such as these (banquet hall, theater, and movie theater) are important to consider in order to cement the project as even more of a destination.

Public recreational areas (outdoor ampitheater, swimming pool) and green spaces (orchard, garden, park, farm) wll be benefial to the spatial urban sequence and destinations along the project.

Urban Housing: This architectural typology is a central design component for the overall scheme of the proposed bridge. It addresses a unique opportunity to grant the "air-right" over the Monagahela River to the inhabitants. It attempts to fill a void of housing within the downtown area of Pittsburgh. It also allows for a modular design system that works well with standard bridge structure and design.

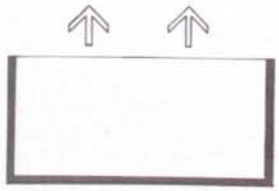
Retail/Service: The varied types of retail and scale issues present a good opportunity for diversifying the proposed bridge. From gifts to groceries; clothing to electronics; the design possibilities are infinite. Restaraunts and bars would contribute to extending the nightlife hours of downtown Pittsburgh as well.

Office: An opportunity for office space among the housing and retail program poses a unique situation where the standard human conditions of work, live and play can be fullfilled in the same space.

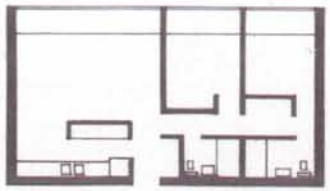
Culture: The goal of creating a destination point from a piece of infrastrucutre can be aided by cultural programming. Gallery space, museum halls and/or an ampitheater all could contribute.

Public/Outdoor: Being a link between several public and outdoor spaces found in downtown Pittsburgh and the South Shore in addition to the expansive sense of spatial freedom found floating over a river make for a chance to create public outdoor space for leisure and activites on the bridge.

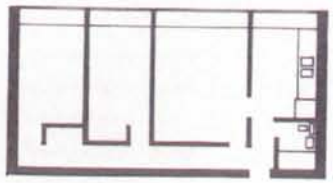
Housing_Unit Types



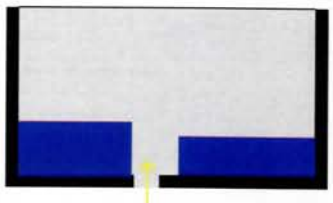
Single-orientation

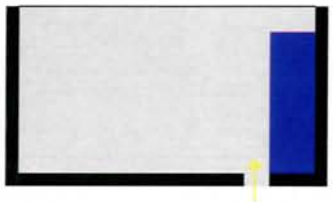


Single-orientation;
core along corridor



Single-orientation;
transverse core



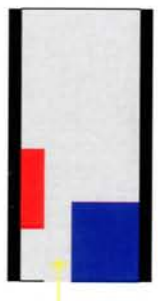


Core/Kitchen Circulation

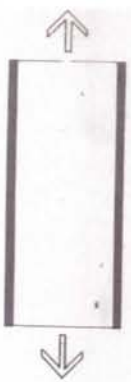
Double-orientation
(o.e.); int. kitchen,
tranverse stair

Double-orientation
(o.e.); int. kitchen,
longitudinal stair

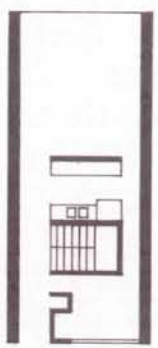
Double-orientation
(o.e.); ext. kitchen,
transverse stair

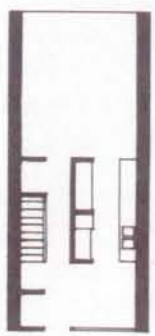


Double-orientation
(o.e.); ext. kitchen,
longitudinal stair



Double-orien-
tation (open-
ended)



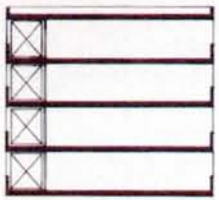


There are 3 general housing unit types: Single-orientation, Double-orientation (90 degrees), and Double-orientation (open-ended). Double-orientation (90 degrees) is not looked at due to the fact that it only works well as a corner condition/ part of a tower housing type. The differences between specific types of single-orientation and double-orientation (o.e.) are minimal, but maintain a design importance for this project. In order to create optimal living conditions, aesthetic appeal, environmental sustainability and clarity in design each subgroup of these two general housing unit types must be analyzed.

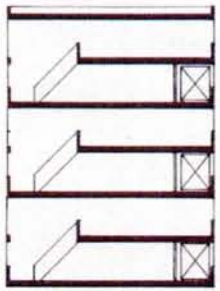
All diagrams source: Modern Housing Prototypes

Housing_Circulation Types

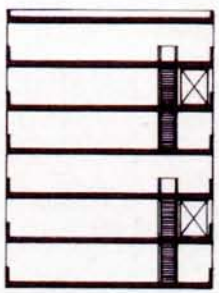
Single loaded; corridor every floor



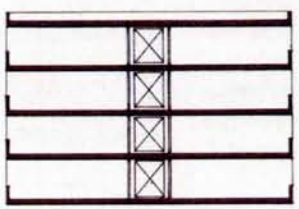
Single loaded; corridor every 2nd floor



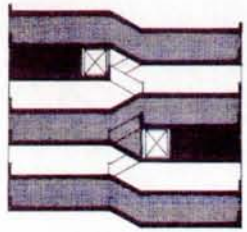
Single loaded; corridor every 3rd floor



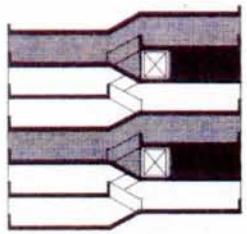
Double loaded; corridor every floor



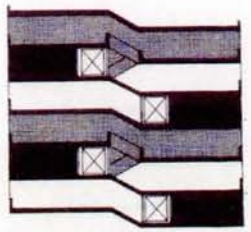
Double loaded split system; corridor every 3rd floor; alternating



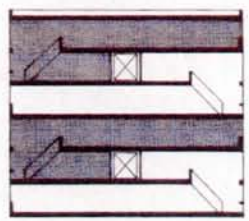
Double loaded split system; corridor every 3rd floor



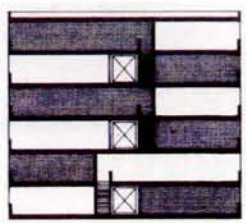
Double loaded split system; corridor every 2nd floor; alternating



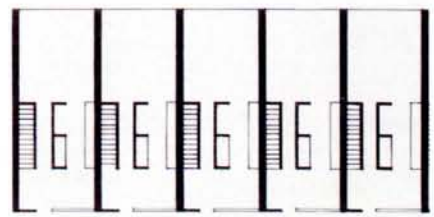
Double loaded; corridor every 3rd floor



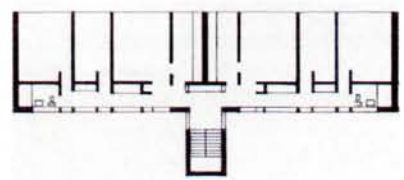
Double loaded; corridor every 2nd floor



For housing there are quite a few circulation types that may apply for a type of housing project on top of a bridge. All allow a specific type of access to units whether by hallway, shared vertical circulation or ground floor entry. Some lend themselves better to a longitudinal oragnization of housing units. The circulatino utilized for this proposal must abide by IBC code, and be the best design solution for the entire project.

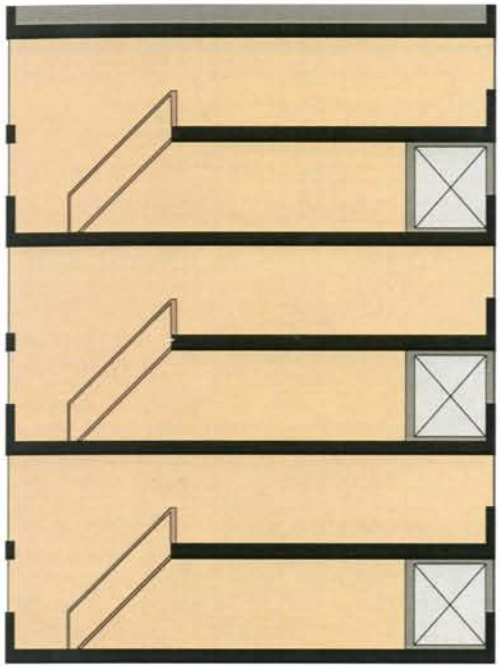


Private access



Multiple vertical access

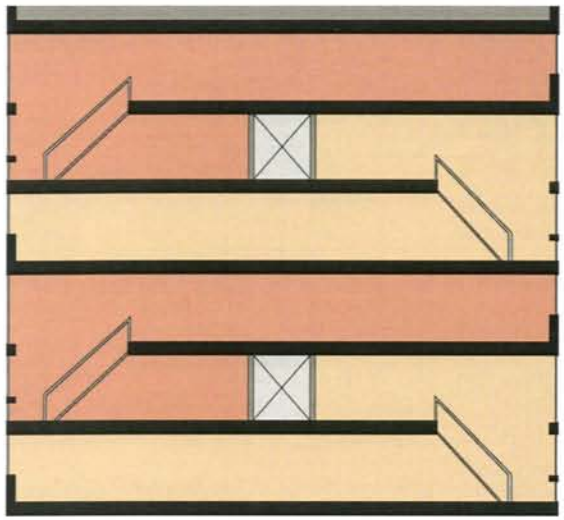
All diagrams source: Modern Housing Prototypes



Single loaded; corridor every 2nd floor

Design Opportunities:
- Corridor on interior of bridge; publicly visible circulation of inhabitants; connection from bridge level to elevated corridors
- Public living spaces can be exposed to river views and double height
- Semi-private spaces on second floor can be exposed to interior of bridge
- Allows for varied unit size/design

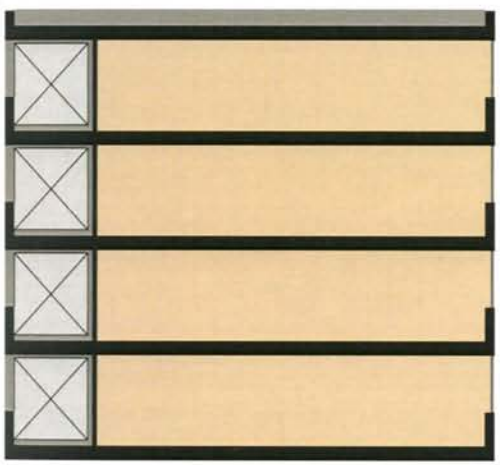
Design Constraints:
- Different sunshine exposure for public/private spaces depending on the side of bridge the unit is on
- Corridor occupies exterior space



Double loaded; corridor every 3rd floor

Design Opportunities:
- Corridor is internalized within building mass; Maximizes exposure of units rather than circulation to window space/sunlight
- Public living and semi-private spaces can be exposed to river views
- A-B-A-B rhythm for orientation of each unit; towards river/towards bridge interior
- Option for living space or private space river views
- Allows for varied unit size/design

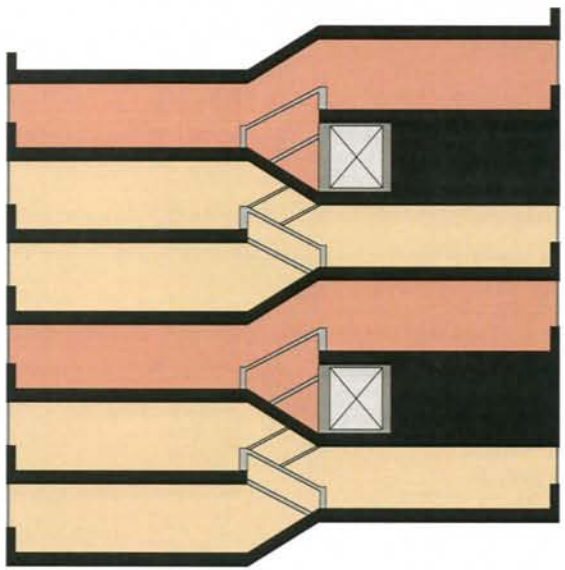
Design Constraints:
- Different sunshine exposure for public/private spaces depending on the side of bridge the unit is on



Single loaded; corridor every floor

Design Opportunities:
- Corridor on interior of bridge; publicly visible circulation of inhabitants; connection from bridge level to elevated corridors
- Public living and semi-private spaces can be exposed to river views
- Simplified stacking arrangement

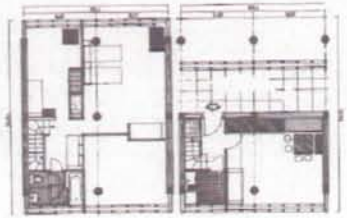
Design Constraints:
- Different sunshine exposure for public/private spaces depending on the side of bridge the unit is on
- Core will have no opportunity for sunshine exposure
- Single level design is limiting
- Corridor occupies exterior space



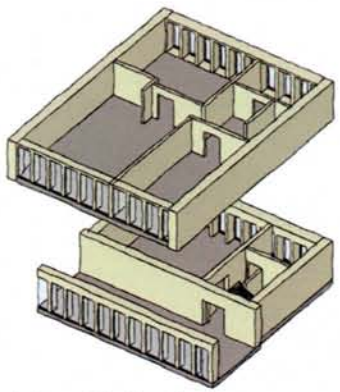
Double loaded split system; corridor every 3rd floor

Design Opportunities:
- Corridor is internalized within building mass; Maximizes exposure of units rather than circulation to window space/sunlight
- Public living and semi-private spaces can be exposed to river views
- A-B-A-B rhythm for orientation of each unit; towards river/towards bridge interior
- Option for living space or private space river views
- Allows for varied unit size/design

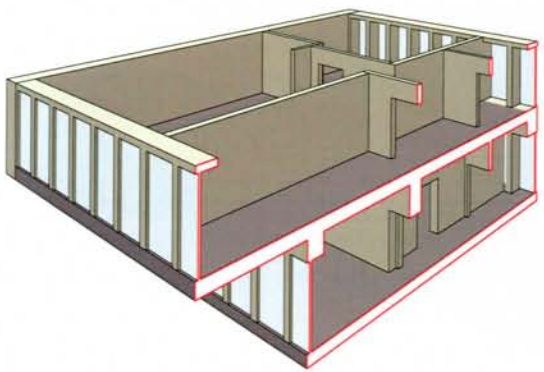
Design Constraints:
- Different sunshine exposure for public/private spaces depending on the side of bridge the unit is on
- Creates awkward space adjacent to corridors



Typical Unit Plan(s): Narkomfin Apartments
source: Modern Housing Prototypes

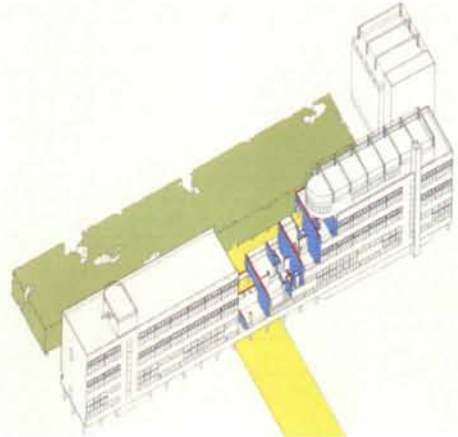


Unit Exploded Axon: Narkomfin Apartments



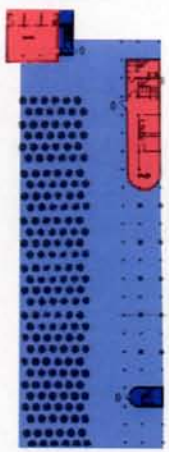
Unit Sectional Perspective: Narkomfin Apartments

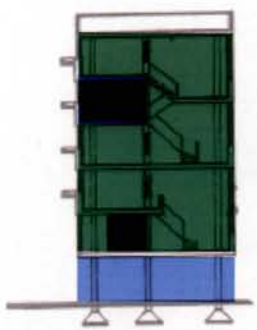
Circulation type: Single-loaded corridor every 3rd fl. Transverse/corridor core; Units have public 1st floor & private 2nd floor; Combines single-orientation with double; Repetitive facade design - not program related; Enclosed access halls.

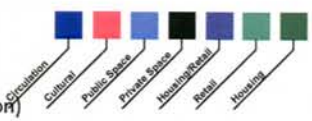


Rendered Axon: Narkomfin Apartments
source: Modern Housing Prototypes

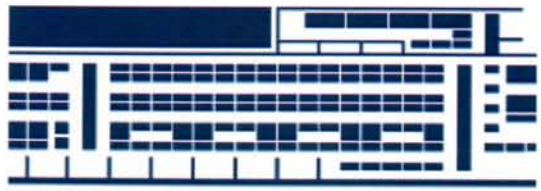
Rendered Perspective: Narkomfin Apartments
source: Modern Housing Prototypes







Program Diagram(s):
Narkomfin Apartments
(ground floor plan & section)



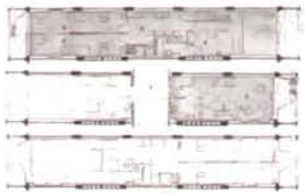
source: Narkomfin.ru

Narkomfin Apartments
Moscow
Moses Ginzburg & I. Milinis
1928

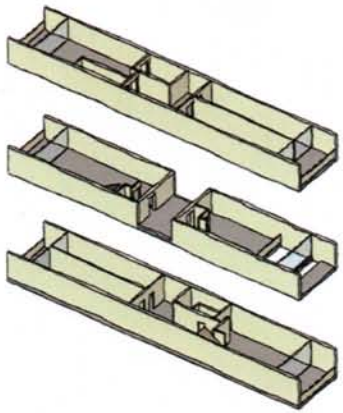
Design Ideal(s): This early housing project in Soviet Russia looked to solve the communist communal living problem. Strikom Units were designs which made for smaller than normal individual family areas, but the communal areas such as bars, gyms, and libraries were larger. This housing unit idea in the Narkomfin was implemented through one-bedroom, two room units and two-bedroom, three room units. Circulation was by a single loaded corridor every three floors. The influence on European housing is very evident.

source: Modern Housing Prototypes

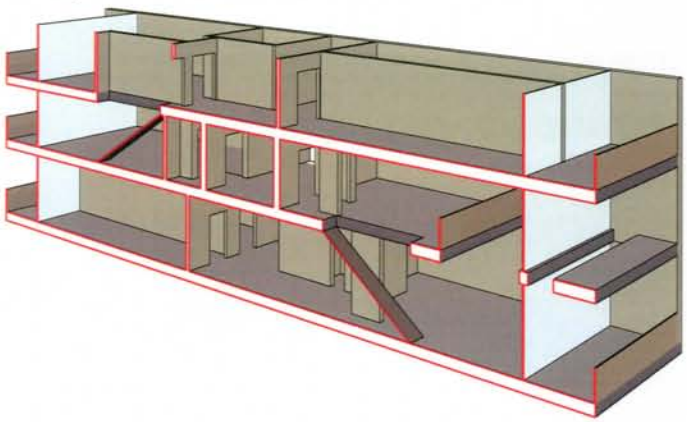
- Communal ground floor
- Dense, compact living
- Focus on communal spaces
- Unique circulation



Typical Unit Plan(s): Unité d'Habitation

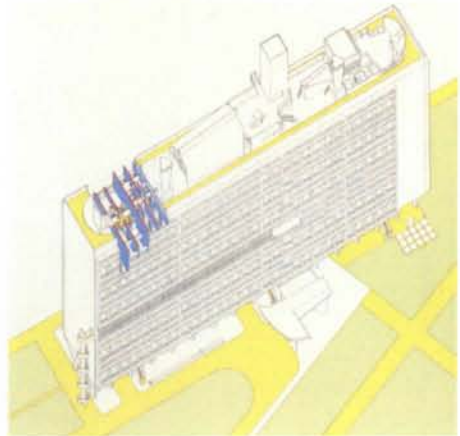


2-Unit Exploded Axon: Unité d'Habitation

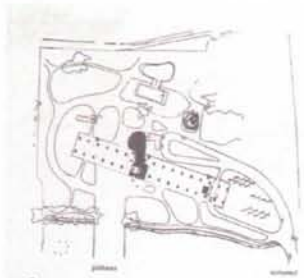


2-Unit Sectional Perspective: Unité d'Habitation

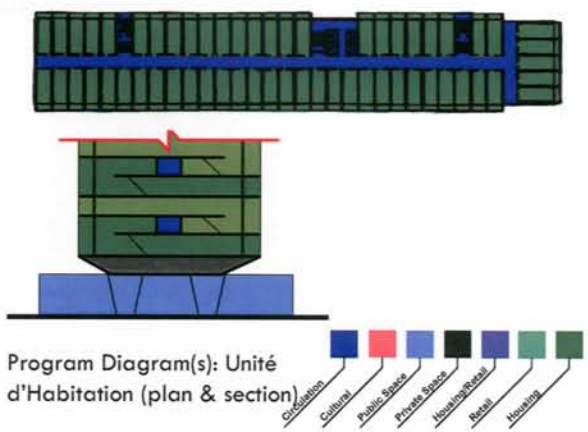
Circulation type: Double-loaded corridor every 3nd fl. Transverse core; Units have public entry floor & public/private full floor; Combines single-orientation with double; Good model to maximize both sides of slab housing.



Rendered Axon: Unité d'Habitation
source: Modern Housing Prototypes



Site Plan: Unité d'Habitation
source: Modern Housing Prototypes



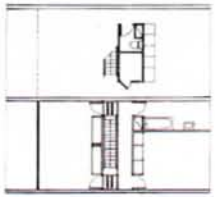
Program Diagram(s): Unité d'Habitation (plan & section)

Unité d'Habitation
Marseilles, France
Le Corbusier &
Nadir Afonso
1947-1952

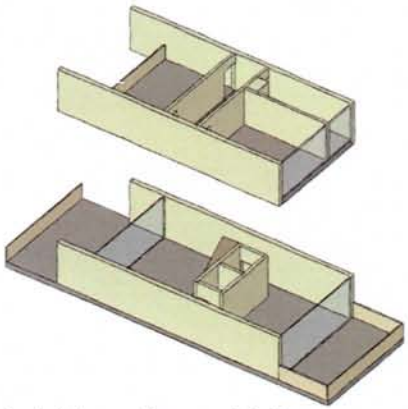
Design Ideal(s): "Le Corbusier's most influential late work was his first significant postwar structure—the UnitÈ d'Habitation in Marseilles. Structurally it is simple: a rectilinear ferroconcrete grid, into which are slotted precast individual apartment units, like 'bottles into a wine rack' as the architect put it. Through ingenious planning, twenty-three different apartment configurations were provided to acccommodate single persons and families as large as ten, nearly all with double-height living rooms and the deep balconies that form the major external feature."

source: Modern Housing Prototypes

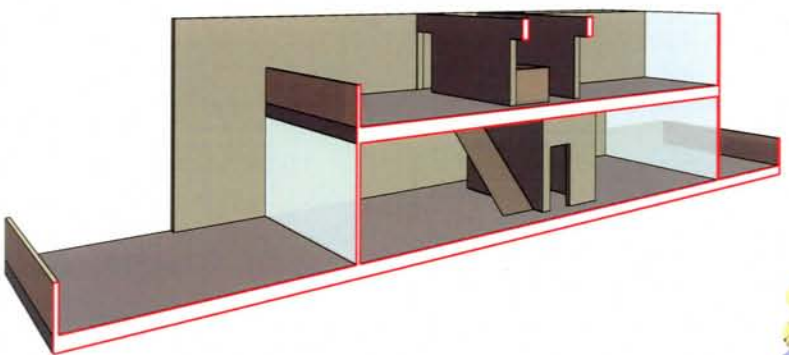
- Skip stop unit design
- Central hall
- Bridge-like
- Public ground floor



Typical Unit Plan(s): Nemasus I & II
source: Housingprototypes.org



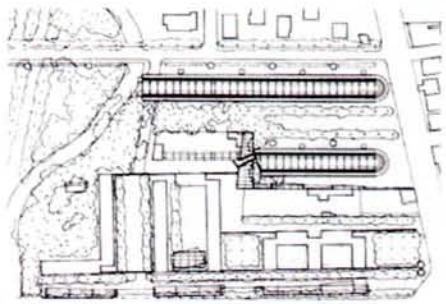
Unit Exploded Axon: Nemasus I & II



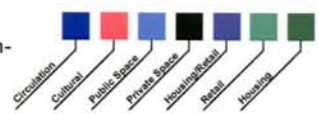
Unit Sectional Perspective: Nemasus I & II

Circulation type: Single-loaded corridor every 2nd fl. Double orientation with interior core and transverse stair; Units have public 1st floor & private 2nd floor; Shared public & private balconies; Cohesive circulation from unit to unit; Exposed access halls.

View of Nemasus I & II



Site Plan: Nemasus I & II
source: Housingprototypes.org



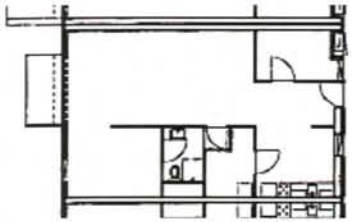
Program Diagram(s): Nemasus I & II (section)

Nemasus I & II
Nimes, France
Nouvell, Jean & Assoc.
1985-87

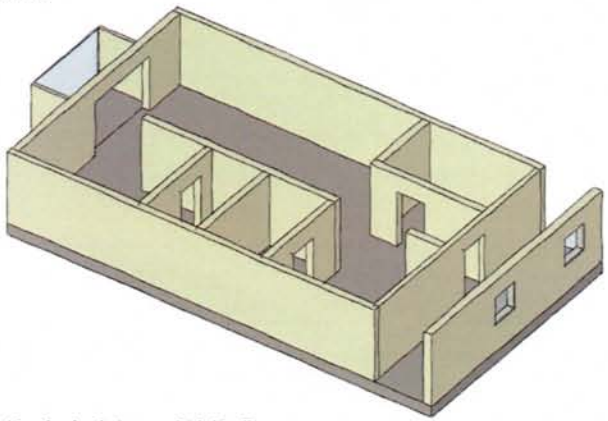
Design Ideal(s): Nemausus was a radical experiment in applying the principles and materials of industrialized building to the construction of social housing. Consistent with other "industrial aesthetic" projects by Nouvell of this period, these two apartment slabs express maritime and aeronautical imagery within the framework of an assemblage of pre-manufactured industrial components.

source: housingprototypes.org

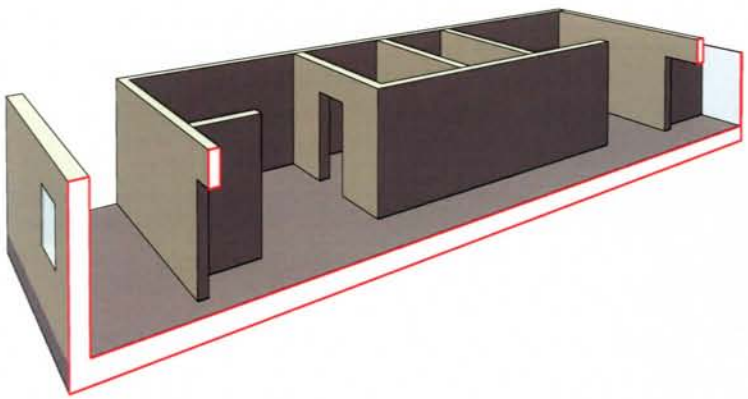
- Tube-like design in plan
- Balconies ring all sides
- Industrial-like design
- Public ground floor



Typical Unit Plan(s): WoZoCo
source: MVRDV



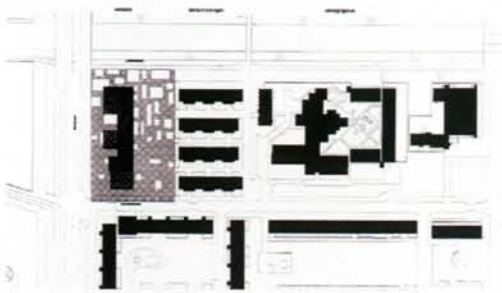
Unit Exploded Axon: WoZoCo



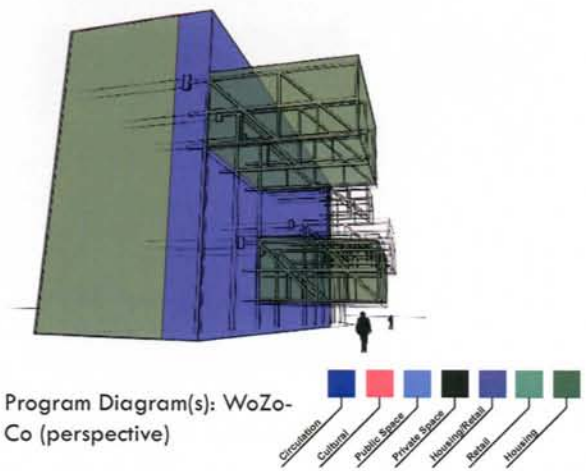
Unit Sectional Perspective: WoZoCo

Circulation type: Single-loaded corridor every fl. Single orientation transverse core; 13 cantilevered units allow exception to single-loaded scheme; Open public space tightly confined private space; Balcony for every unit.

View facing front: WoZoCo



Site Plan: WoZoCo
source: MVRDV



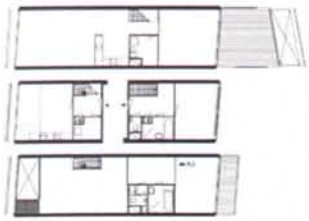
Program Diagram(s): WoZoCo (perspective)

WoZoCo
Amsterdam-Osdorp,
Netherlands
MVRDV
1994-1997

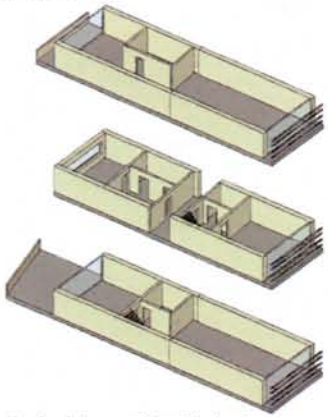
Design Ideal(s): "To still provide adequate sunlight into the surrounding buildings only 87 of the 100 units could be realized within the slab. The North-South orientation of the block meant that the generator had to be a 7.20 meter module. By "cantilevering" the remaining 13 units from the north façade, they are literally suspended in the air. The Spartan gallery flat becomes acceptable. Each gallery is given a different perspective. By changing window positions, balcony sizes and varying balcony materials, the different flats acquire their own character."

source: MVRDV

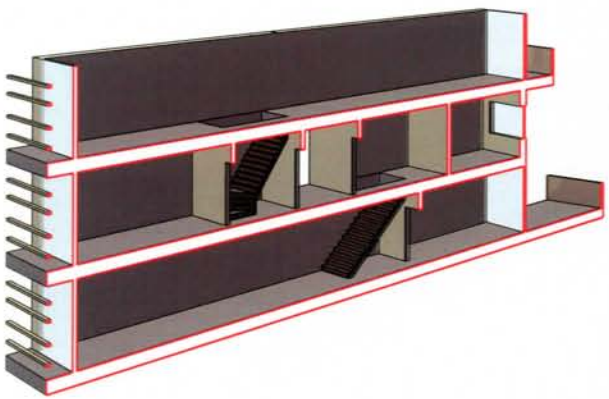
- Light public facing facade
- Combination of old and new
- Carved open space
- Layered design



Typical Unit Plan(s): The Light Factory
source: housingprototypes.org



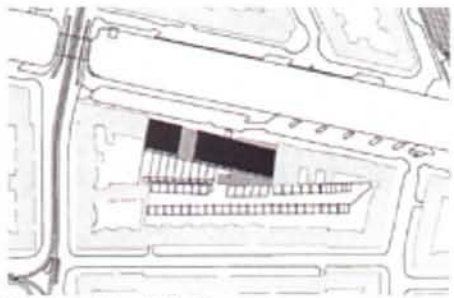
2-Unit Exploded Axon: The Light Factory



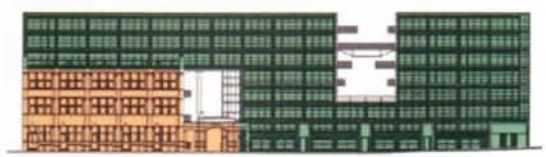
2-Unit Sectional Perspective: The Light Factory

Circulation type: Double-loaded corridor every 3nd fl. Transverse core; Units have public entry floor & public/private full floor; Combines single-orientation with double; Good model to maximize both sides of slab housing.

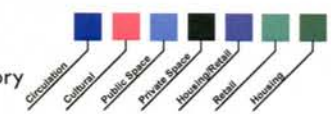
View of Facade: The Light Factory



Site Plan: The Light Factory
source: housingprototypes.org



Program Diagram(s) & Layering: The Light Factory (elevation & unit)

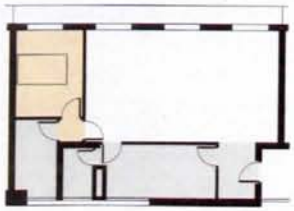


The Light Factory
Amsterdam,
The Netherlands
Köther + Salman
1994-99

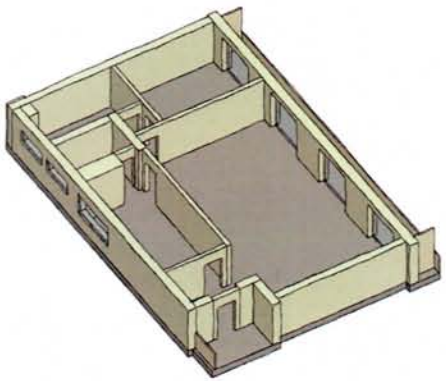
Design Ideal(s): The apartments open to a very narrow balcony along the street (or framed windows in the factory) and to a deeper "veranda" at the opposite end overlooking the interior of the block. Living spaces face the street while bedrooms open to the rear. This forms a striated layered surface that is part balcony, part screen, that is glazed with full height sliding doors and clear glass balustrades.

source: housingprototypes.org

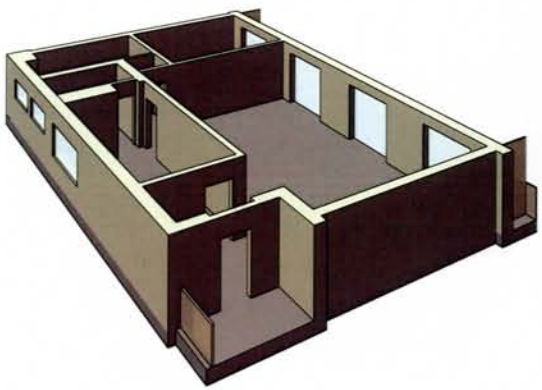
- Light public facing facade
- Combination of old and new
- Carved open space
- Layered design



Typical Unit Plan(s): Social Dwellings
source: New Urban Housing



Unit Axon: Social Dwellings

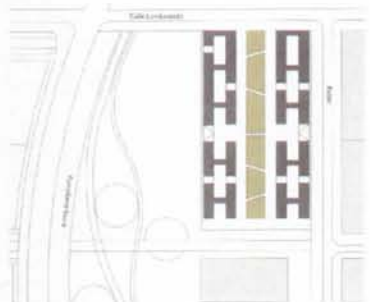


Unit Perspective: Social Dwellings

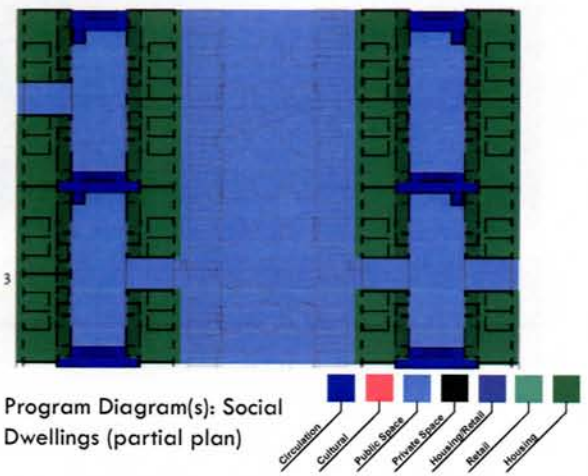
Circulation type: Hybrid: Single-loaded every fl. and multiple floor access

Double orientation with external core; Access to 2-4 units at a time; Shared semi-private balcony space; All spaces exposed to sunlight.

Views of interior atrium: Social Dwellings



Site Plan: Social Dwellings
source: New Urban Housing



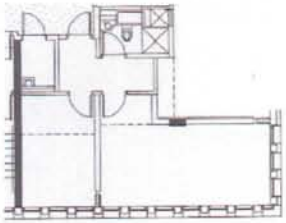
Program Diagram(s): Social Dwellings (partial plan)

Social Dwellings
Lakua, Vitoria, Spain
Ercilla & Campo Architecture
2002

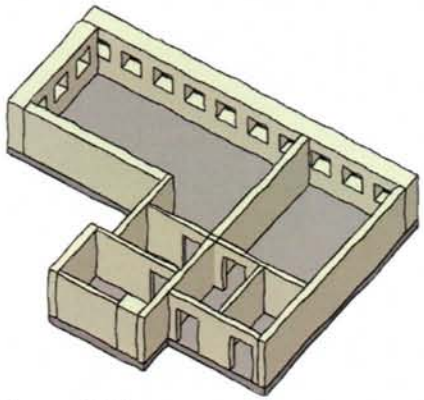
Design Ideal(s): Design strategy here was to set in green open space first, and then arrange units to maximize lighting. Large covered garden spaces exist on the interiors of the housing blocks as well as views of exterior spaces. All of the apartments are the same, except for width differences between the two and three-bedroom units. Each apartment is designed so that all of the space (minus kitchen and bathroom) can be partitioned out by the owners. Issues with circulation and privacy were solved by covering the interior space then adding vertical circulation at either end - which makes a large, public, hybrid circulation zone.

source: New Urban Housing

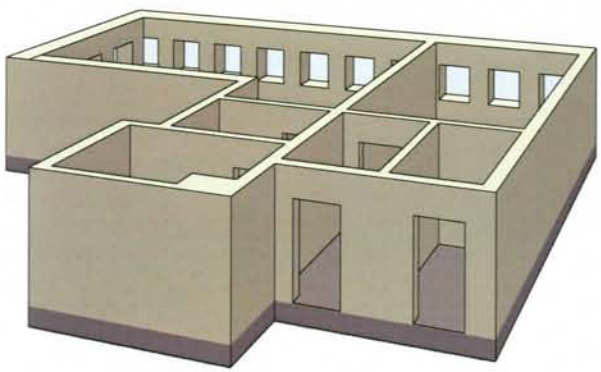
- Hybridized, large and public circulation
- Free design for each unit
- Emphasis on views



Typical Unit Plan(s): Simmons Hall
source: New Urban Housing

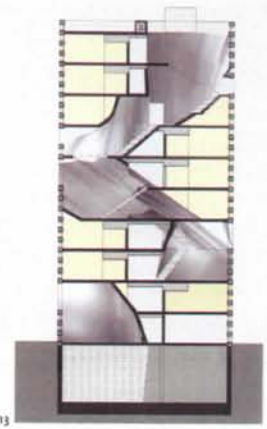


Unit Axon: Simmons Hall



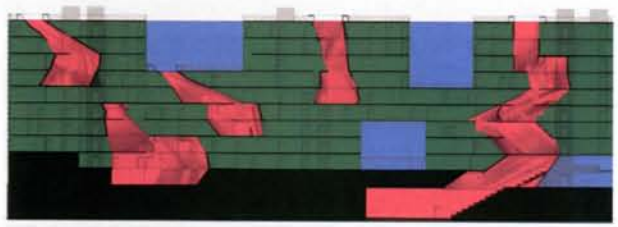
Unit Perspective: Simmons Hall

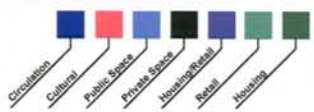
Circulation type: Single-loaded every fl.
Single orientation with corridor core; Units range in size to accomodate 1-4 students; Many different unit forms speak to cohesive mix of different program (retail, culture, etc.) with housing unit.



View of facace & Rendered Section: Simmons Hall
source: New Urban Housing

Site Plan: Simmons Hall
source: New Urban Housing





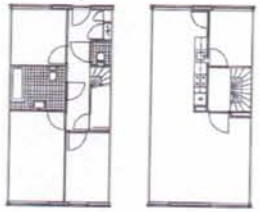
Program Diagram(s): Simmons Hall (plan & section)

Simmons Hall, MIT
Cambridge, MA
Steven Holl Architects
2002

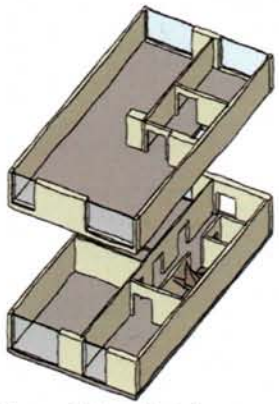
Design Ideal(s): Simmons Hall has been likened to Corbusier's Unite project as a reinterpretation of th model. In this project there is a contrast of form - the linear, geometric grid of the structure and housing unit pattern against free-flowing public spaces using thin concrete. Color is also used to code groupings of 'houses' together. An internal 'street' is another highlight due to its width and the program found along it. Within a college dorm there is anything from retail, to fashion, or electronics, but as something unique Holl also added restaraunt facilities and a theater.

source: New Urban Housing

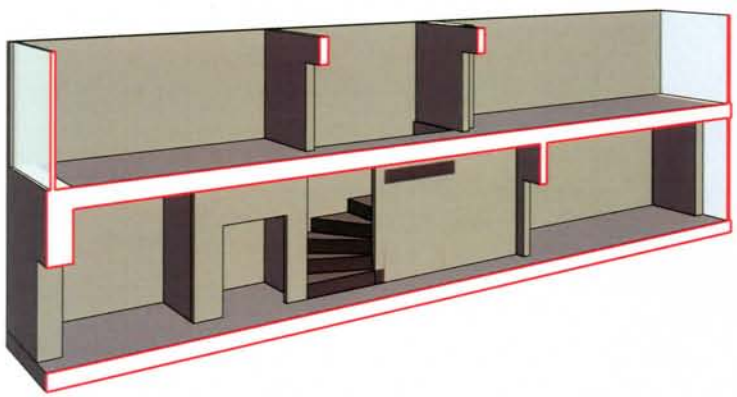
- Contrast of gridded design with free-form space
- Color scheme
- large circulation paths and lots of program



Typical Unit Plan(s): Schots 1 + 2
source: New Urban Housing

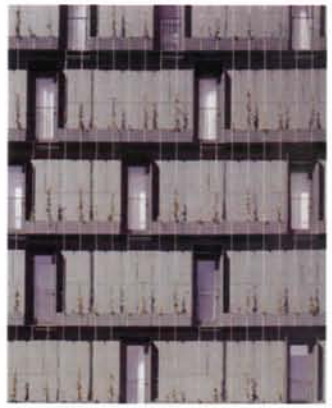


Unit Exploded Axon: Schots 1 + 2



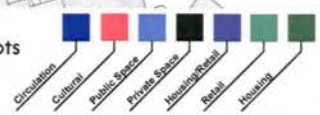
Unit Sectional Perspective: Schots 1 + 2

Circulation type: Hybrid: Single-loaded every fl., every 2nd fl. and private access
Double/single orientation with transverse/internal core;
Units range from 1 floor to 4; Many different unit types speak to varied program accomodations.



Views of different facades: Schots 1 + 2

Site Plan: Schots 1 + 2
source: New Urban Housing



Program Diagram(s): Schots 1 + 2 (site plan)

Schots 1 + 2
Groningen, The Netherlands
s333 Architecture + Urbanism
2002

Design Ideal(s): A hybrid urban structure that combines the form of the traditional city - closed blocks defining streets - with the Modernist ideal of isolated building set in green space. Schots 1 + 2 are designed so that they seem to appear as a continuation of the three-dimensional landscape - cut into or growing from. The form of the buildings are cranked around each other to create courtyard spaces. Programatically, Schots 1 + 2 were designed to accomodate all ranges of inhabitants - the elderly, students, families, etc. A shopping "street" cuts between Schots 1 + 2 creating a rhythm of A-B-A-C-A-B-A (A=building, B= semi private courtyard, C=retail street).

source: New Urban Housing

- Varied facde design
- street level retail
- grown from or cut into landscape

TABLE 1004.1.1
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

FUNCTION OF SPACE	FLOOR AREA IN SQ. FT. PER OCCUPANT
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Assembly with fixed seats	See Section 1004.7
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	100 gross
Courtrooms—other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
H-5 Fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mercantile	
Areas on other floors	60 gross
Basement and grade floor areas	30 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

For SI: 1 square foot = 0.0929 m².

TABLE 1005.1
EGRESS WIDTH PER OCCUPANT SERVED

OCCUPANCY	WITHOUT SPRINKLER SYSTEM		WITH SPRINKLER SYSTEM[a]	
	Stairways (inches per occupant)	Other egress components (inches per occupant)	Stairways (inches per occupant)	Other egress components (inches per occupant)
Occupancies other than those listed below	0.3	0.2	0.2	0.15
Hazardous: H-1, H-2, H-3 and H-4	0.7	0.4	0.3	0.2
Institutional: I-2	NA	NA	0.3	0.2

For SI: 1 inch = 25.4 mm. NA = Not applicable.

TABLE 1016.1
EXIT ACCESS TRAVEL DISTANCE[a]

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A, E, F-1, I-1, M, R, S-1	200	250[b]
B	200	300[b]
F-2, S-2, U	300	400[b]
H-1	Not Permitted	75[b]
H-2	Not Permitted	100[b]
H-3	Not Permitted	150[b]
H-4	Not Permitted	175[b]
H-5	Not Permitted	200[b]
I-2, I-3, I-4	150	200[c]

For SI: 1 foot = 304.8 mm.

a. See the following sections for modifications to exit access travel distance requirements:
Section 402: For the distance limitation in malls.
Section 404: For the distance limitation through an atrium space.
Section 1016.2 For increased limitations in Groups F-1 and S-1.
Section 1025.7: For increased limitation in assembly seating.
Section 1025.7: For increased limitation for assembly open-air seating.
Section 1019.2: For buildings with one exit.
Chapter 31: For the limitation in temporary structures.

b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems in accordance with Section 903.3.1.2 are permitted.

c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

TABLE 1019.1
MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

OCCUPANT LOAD (persons per story)	MINIMUM NUMBER OF EXITS (per story)
1-500	2
501-1,000	3
More than 1,000	4

Note:
Use and Occupancy Classification (that may be used):
- Assembly Group A
  (subgroups A-1, A-2, A-3, A-4)
- Business Group B
- Mercantile Group M
- Residential Group R
  (subgroups R-1, R-2)

Means of Egress

Section 1003
General Means of Egress

1003.2 Ceiling height. The means of egress shall have a ceiling height of not less than 7 feet 6 inches.

1003.4 Floor surface. Walking surfaces of the means of egress shall have a slip-resistant surface and be securely attached.

1003.5 Elevation change. Where changes in elevation of less than 12 inches exist in the means of egress, sloped surfaces shall be used. Where the slope is greater than a 5% slope, ramps shall be used. Where the difference in elevation is 6 inches or less, the ramp shall be equipped with either handrails or floor finish materials that contrast with adjacent floor finish materials.

Section 1004
Occupant Load

See Table 1004.1.1

Section 1005
Egress Width

See Table 1005.1

Section 1014
Exit Access

1014.2 Egress through intervening spaces. Egress through intervening spaces shall comply with this section.

1. Egress from a room or a space shall not pass through adjoin or intervening rooms or areas, except where such adjoining rooms or areas are accessory to the area served, are not a high-hazard occupancy and provide a discernible path of egress travel to an exit.
2. Egress shall not pass through kitchens, storage rooms, closets or spaces for similar purposes.
3. An exit access shall not pass through a room that can be locked to prevent access.
4. Means of egress from dwelling units or sleeping areas shall not lead through other sleeping areas, toilet rooms or bathrooms.

1014.2.1 Multiple tenants. Where more than one tenant occupies any one floor of a building or structure, each tenant space, dwelling unit and sleeping unit shall be provided with access to the required exits without passing through adjacent tenant spaces, dwelling units and sleeping units.

1014.3 Common path of egress travel. In occupancies other than Groups H-1, H-2 and H-3, the common path of egress shall not exceed 75 feet.

Exceptions:
1. The length of a common path of egress travel in Group B, F and S occupancies shall not be more than 100 feet provided that the building is equipped throughout with an automatic sprinkler system.
2. The length of a common path of egress travel in Group R-2 occupancies shall not be more than 125 feet provided that the building is equipped throughout with an automatic sprinkler system.

Section 1016
Exit Access Travel Distance

See Table 1016.1

Section 1019
Number of Exits and Continuity

See Table 1019.1

source: International Building Code 2006

Keystone Principles & Criteria for Growth, Investment & Resource Conservation

1. Redevelop First
2. Provide Efficient Infrastructure
3. Concentrate Development
4. Increase Job Opportunities
5. Foster Sustainable Businesses
6. Restore & Enhance the Environment
7. Enhance Recreational & Heritage Resources
8. Expand Housing Opportunities
9. Plan Regionally; Implement Locally
10. Be Fair

LEED 2009 for New Constuction & Major Renovation

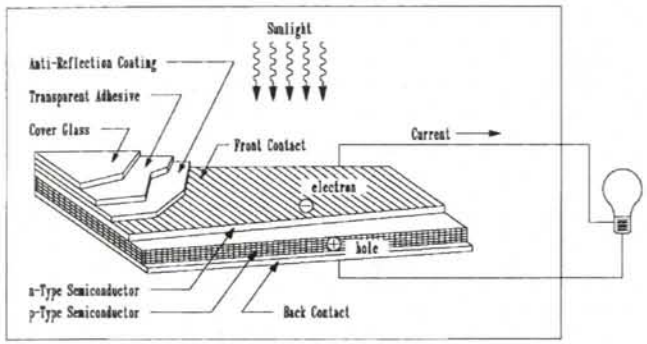
1. Sustainable Sites (26 points)
2. Water Efficiency (10 points)
3. Energy & Atmosphere (35 points)
4. Materials & Resources (14 points)
5. Indoor Environmental Quality (15 points)
6. Innovation & Design Process (6 points)
7. Regional Priority Credits (4 points)

Total possible points: 110

"Sustainable architecture is a general term that describes environmentally-conscious design techniques in the field of architecture. Sustainable architecture is framed by the larger discussion of sustainability and the pressing economic and political issues of our world. In the broad context, sustainable architecture seeks to minimize the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space. Most simply, the idea of sustainability, or ecological design, is to ensure that our actions and decisions today do not inhibit the opportunities of future generations. This term can be used to describe an energy and ecologically conscious approach to the design of the built environment."
source: Wikipedia

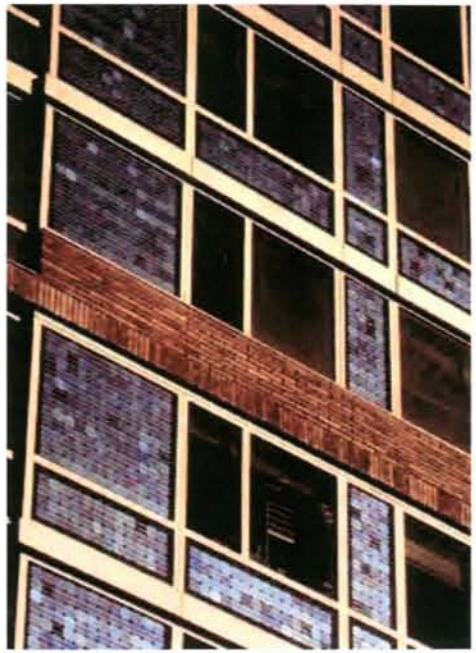
In regards to a programmed bridge, sustainable technologies are highly viable. This is due to the location of the bridge in general. The highly exposed piece of infrastructure in the open space over a waterway can utilize solar, wind and water related technologies relatively easily. The opportunity is there to take advantage of the bridge's exposure to nature. A study of the site's climate and ecological condition in conjunction with modern 'green' technologies/design techniques can yield potent results. A close following of USGBC's LEED Certification requirements and Pennsylvania's own Keystone Principles & Criteria for Growth, Investment & Resource Conservation will ground the additional care taken towards sustainable architecture within the design.

Sustainability_Solar



Basic construction of pv cell with performance enhancing features (current collecting mesh, anti-reflective coating and cover glass protection)
source: Wind & Solar Power Systems

The simple technology of photovoltaics can be integrated into architectural design very easily. They can be an addition to roof and facade systems or their own stand-alone object. The housing project pictured to the right, The Solaire - smoothly includes photovoltaics into its exterior cladding. That is just one of many possible solutions to architecture and sustainable technologies being combined.



Solar energy is a huge source of renewable fuel. Within its site, this bridge project can use an entire day's worth of solar energy in order to supplement its infrastructural, electrical, and heating/cooling needs. Proper use of southern exposure, photovoltaic panels, and other solar-based green technologies/design techniques can greatly aid the overall efficiency of the bridge and diminish its carbon footprint. However, the site sunshine conditions are not entirely ideal for solar energy due to the amount of cloudy days Pittsburgh has regularly.

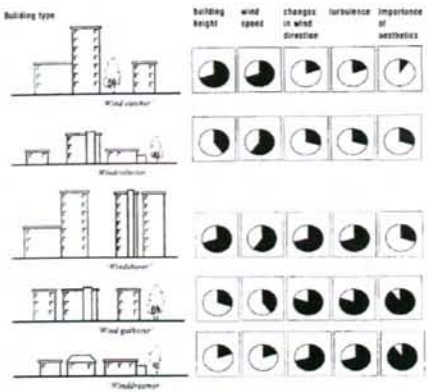
Case Study

Kurilpa Bridge
Brisbane, Queensland, Australia
Cox Rayner Architects and Arup Engineers
2009

"Spanning 470 meters, the footbridge - said to be the longest bridge of its kind - features a LED lighting system that is powered almost completely by 84 integrated solar panels which produce and average of 100KWh a day. And because it is connected to the grid, the bridge can get power when needed or give power back to the grid when a surplus is generated."
source: Archi-europe.com

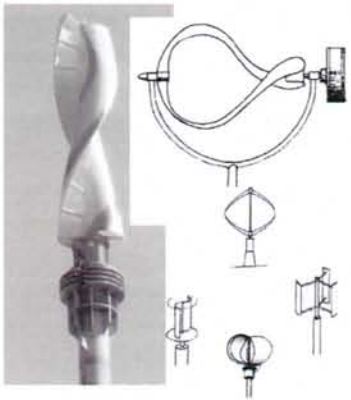
The unique structural and solar system in place on this bridge makes it an interesting precedent to study. The smooth integration of the two systems speaks to the opportunity to combine infrastructure, program and sustainable technologies.

Sustainability_Wind



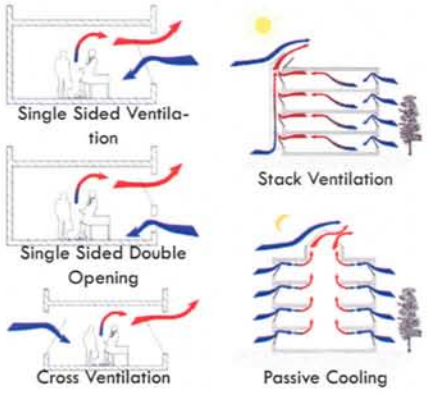
Categories of building cluster and their effectiveness for wind generation
source: Architecture in a Climate of Change

Important concept of wind generation that applied to the exposed bridge project will affect the mass vs. space design decisions in order to maximize the effectiveness in capturing wind energy.



Vertical axis wind turbine types
source: Architecture in a Climate of Change

These types of turbines are ideal for an urban setting because they are discrete, create very little noise and can be integrated into buildings easily.



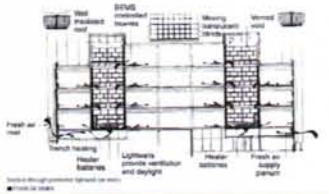
Natural ventilation systems
source: Dyer Environmental

These general diagrams of natural ventilation variation may be integrated in a project to cut down emissions from a building.

Case Studies

Interstate 5 Bridge
Vancouver, Washington - Portland Oregon
Bradley Touchstone
2009 - unbuilt

These two designs to be implemented for the Columbia River Crossing try to take the green standard of the region and apply it to its infrastructure. They are both subtle, but effective in their installation. One is a design that features vertically spinning turbines and the other has helix-shaped wind turbines which stand more than 10 feet tall mounted in transparent cylinders above the roadway.

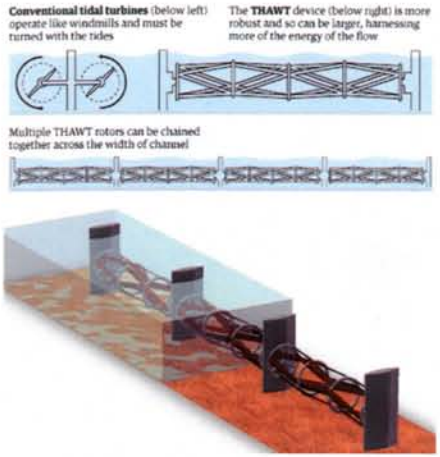


Coventry University Library
Coventry, UK
Short and Associates
2009 - unbuilt

This building uses a good cross-ventilation strategy. It provides each quadrant of the floor plan with large lightwells doubling up as air delivery shafts. The buoyancy of rising warm air draws fresh air into plenums below floor level to the base of each light tower. From here the air is drawn upwards through preheating coils to be released to rooms at floor level. With control systems in place, the library can be ventilated well.

Wind energy is an important renewable resource. Within its site, this bridge project can use the daily wind flows and capture its inherent energy in order to supplement its infrastructural, electrical, and heating/cooling needs. The high exposure to wind that the bridge has being sited in an open-air location, makes the possibility of utilizing natural ventilation strategies for better air quality and heating/cooling techniques as well. Proper use of wind patterns, energy generating wind turbines, and passive ventilation design techniques can greatly aid the overall efficiency of the bridge and diminish its carbon footprint.

Sustainability_Water

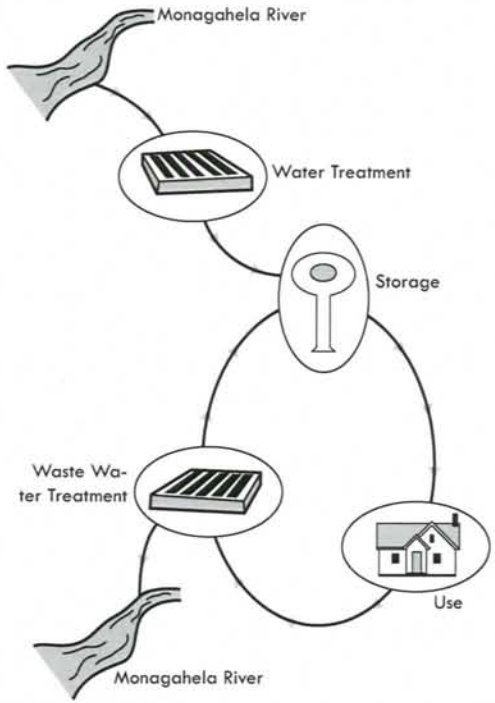


Tranverse Horizontal Axis Water Turbine
source: inhabit.com

These advanced underwater turbines developed by Oxford University engineers, are one example of a water turbine that is ideal for a river environment.

Water Treatment Diagram

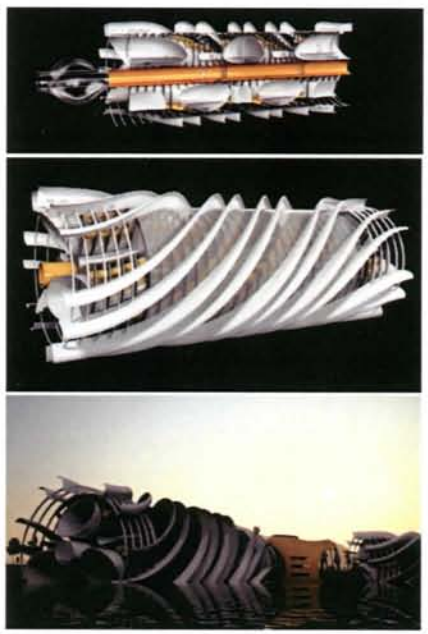
This diagram shows the flow of water from its origin (in this case a the Monagahela River) into a cycle that can also be broken and released back into the river. Using the water that the programmed bridge is built over top of is an opportunity that can greatly increase the sustainabilty of the entire project. Water treatment and brown-water reuse will help to offset the demands of the bridge's inhabitants and users.



Hydro-electric energy is a huge source of renewable fuel and water itself from a waterway can be utilized as well. Within its site, this bridge project can use the waterway it crosses and the energy generated from its current in order to supplement its infrastructural, electrical, and heating/cooling needs. Water can be siphoned from the river as well to supplement those needs too. With proper water treatment, it can be utilized to supply water to the inhabitants of the bridge for drinking and be a source for hydroponic farming. Proper use of the potential energy from river currents, hydro-electric turbines, water treatment and hydroponics can greatly aid the overall efficiency of the bridge and diminish its carbon footprint.

Case Study

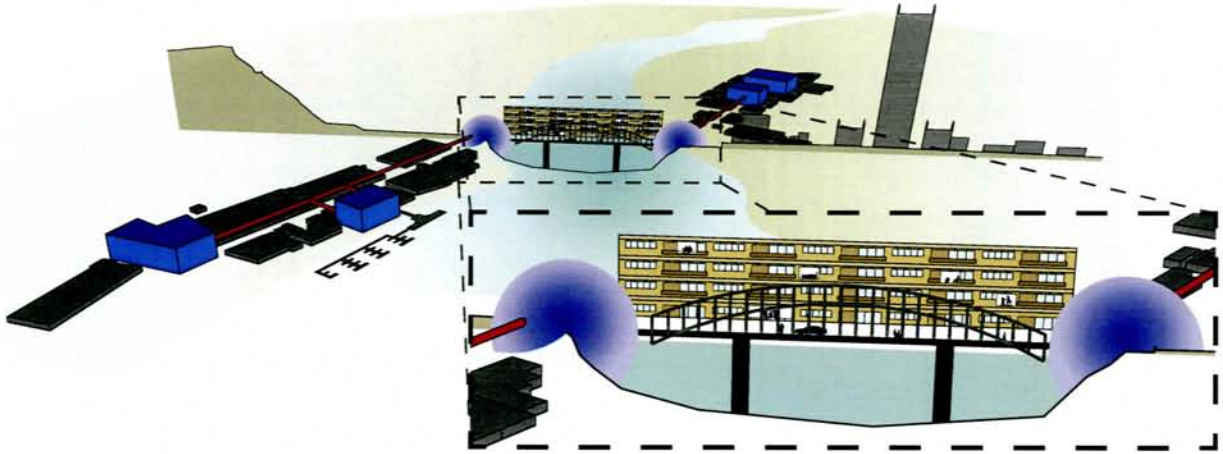
Hydroelectric House
GRO Architects
2009 - unbuilt



"GRO Architects' floating walkways are designed to extend from piers and use the river current to spin their large turbines. Power would be generated silently while the passersby could also use the spaces within the network of turbines for walkways, public spaces, or housing."
source: inhabitat.com

The ideas found within a project such as this F2H Housing design are translatable to a programmed bridge. Both the nodal points and the structural supports of the bridge itself are able to have 'programmed hydro-electric systems' attached to them.

Conclusions



With primary drivers of design (bridge and housing) along with the secondary drivers (site, programmed bridge, non-housing program and sustainability) the design of an inhabited bridge that fulfills its thesis goals can be accomplished.

Site: A background of data on the city of Pittsburgh, PA allows intelligent site-specific design decisions to be made. General information on Pittsburgh's demographics, economic situation, history, climate and wind/solar data is integral to moving forward. Design that supplements the rich culture, solid economy and diverse program of the city while integrating the pre-existing climate conditions will create opportunities for a successful urban intervention through an inhabited bridge.

Site (specific): The urban sequences, program and spaces on either side of the Monagahela River allow for an intervention that adds to the existing site. A closer examination of what exactly the inhabited bridge connects into cements the exact site of an inhabited bridge. This is due to the diversity and opportunity that Destination A and B have.

Programmed Bridges: A catalogue of both traditional and contemporary programmed bridges allows for informed design decisions as the process continues. The traditional bridges are important to understand courtesy of their strong integration in the urban fabric of their cities. Contemporary programmed bridges offer new urban sequence intervention studies and modern design strategies to inform the design process of an inhabited bridge in Pittsburgh.

Bridges: Understanding the structural demands of purely infrastructural bridges helps to narrow down ideal bridge forms to incorporate programming. The diversity of structural solutions creates an opportunity to utilize an aesthetically pleasing and structurally efficient bridge design. Knowing what exactly the nearby bridges of Smithfield Street Bridge and Fort Pitt Bridge entail and demand structurally aids the design process for a bridge of similar design needs.

Program: Studying the existing program of Destinations A and B in conjunction with knowing what different types of program can contribute to a composite typology allows for successful program implementation in proposed design schemes.

Housing: With a study of both housing unit/circulation types and housing precedents, the diversity of possibilities for this program type can be realized. It is the most important program to be added to this new urban intervention, and along with bridges, is the other primary driver of design decisions.

Sustainability: The exposure of the new design of an inhabited bridge to climate, wind and solar energy is a design opportunity that cannot be underutilized. As a secondary driver of design, sustainable technology could be a great supplement to the overall design of the inhabited bridge.

Thesis Contention:

By taking this historic composite typology and redeploying it within a contemporary urban context, it is possible to address a series of related architectural and urban issues simultaneously. These issues/objectives are:

1. The composite typology of bridge, housing and mixed-use (retail/commercial) functions creates a synergistic relationship among the individual program types that enriches the whole.
2. An economy of means is accomplished by combining a normally stand-alone infrastructural element (i.e. a bridge) with other building types (i.e. housing).
3. The insertion of the programmed bridge into a site changes the traditional role of bridge as merely infrastructure for automobiles into a new destination within its context affording the bridge the inherent opportunity to create new civic space.
4. The two places where this new bridge type touches down can now operate as both the end points and nodal instigators. They offer the opportunity to stimulate urban growth by projecting new activity, programming and users into pre-existing static site condition.
5. Where these site conditions are part of two previously disconnected urban sequences, the inhabited bridge now offers the opportunity to join these sequences into a greater and more significant whole creating a spatial continuity between two disparate parts of the city.

Bibliography

"About: WoZoCo." MVRDV. 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.mvrdv.nl/#/projects/housing/015wozoco>.

THE BAY LINE. THE BAY LINE: A case study in the adaptive reuse of abandoned bridges for landscape and urbanism. San Fratello Architects, 2009. Web. 14 Dec. 2009. <http://sf.streetsblog.org/wp-content/upload1/TheBayLineWPA2.O.PDF>.

Bogdan, Lea. "Flood Harvesting Housing Brings Tidal Power to New York City." Web log post. Inhabitat, 7 Oct. 2009. Web. 14 Dec. 2009. <http://www.inhabitat.com/2009/10/07/energy-harvesting-turbines-for-nyc-get-a-style-update/>.

Chen, Olivia. "Oxford Unveils Next-Gen Underwater Turbines." Web log post. Inhabitat, 10 Sept. 2008. Web. 14 Dec. 2009. <http://www.inhabitat.com/2008/09/10/oxford-engineers-transverse-horizontal-axis-water-turbine/>.

"City of Pittsburgh Maps." City of Pittsburgh, Pennsylvania - Pghgov.com. 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.city.pittsburgh.pa.us/cp/maps/>.

Cridlebaugh, Bruce S. Bridges and Tunnels of Allegheny County and Pittsburgh, PA - pghbridges.com. 2008. Web. 14 Dec. 2009. <http://www.pghbridges.com/>.

Curtis, Jan. "Wind Rose Data." NRCS National Water and Climate Center | Home. 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.wcc.nrcs.usda.gov/climate/windrose.html>.

DAN HISEL ARCHITECT. 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.danhiseldesign.com/index.html>.

"Darlington Digital Library Maps: 1 to 20 of 44 hits." Darlington Digital Library. University of Pittsburgh, 14 Dec. 2009. Web. 14 Dec. 2009. <http://images.library.pitt.edu/cgi-bin/i/image/image-idx?type=boolean;view=thumbnail;med=1;button1=Go;q1=pittsburgh;rgn1=darlmaps_all;corig=darlmaps;start=21;sid=980981ca29bdc28ad4a74d734accbdae;size=20;c=darlmaps>.

French, Hilary. New Urban Housing. New York: Yale UP, 2006. Print.

"Glass Bridge." Horden Cherry Lee Architects | welcome. 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.hcla.co.uk/projects/?prorub1=ap&prorub2=9&pid=75>.

The Happy Pontist. 10 Dec. 2009. Web. 14 Dec. 2009. <http://happypontist.blogspot.com/>.
"Keystone Principles : newPA.com." Home : newPA.com. New PA, 2009. Web. 14 Dec. 2009. <http://www.newpa.com/find-and-apply-for-funding/keystone-principles/index.aspx>.

International Code Council. 2006 International Building Code - Softcover Version Softcover Version (International Building Code). Belmont: Cengage Delmar Learning, 2006. Print.

"Kurilpa Bridge." Cox Architects, 2009. Web. 14 Dec. 2009. <http://www.cox.com.au/projects.aspx?projectId=4104&disciplineId=1207>.

"LEED for New Construction." USGBC - LEED for New Construction. USGBC, 2009. Web. 14 Dec. 2009. <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220>.

Levy, Francesca. "Full List: America's Fastest-Recovering Cities." Forbes.com. Forbes, 19 Nov. 2009. Web. 14 Dec. 2009. <http://www.forbes.com/2009/11/19/cities-recovery-unemployment-lifestyle-real-estate-top-ten-chart.html?partner=msnbc>.

Living Bridge. Advertisement. LIV_de.pdf. BRT Architekten, 2007. Web. 14 Dec. 2009. <http://www.livingbridge-hamburg.de/img/LIV_de.pdf>.

Living bridges the inhabited bridge, past, present and future. London: Royal Academy of Arts, Prestel, 1996. Print.

Living Bridge Hamburg. City of Hamburg, 2007. Web. 14 Dec. 2009. <http://www.belebte-bruecke.de/>.

Mimram, Marc. Living Bridges. LaFarge, 1 Oct. 2008. Web. 14 Dec. 2009. <http://www.lafarge.com/10012008-publication_research_innovation-marc_mimram_brochure-uk.pdf>.

"Natural Ventilation Systems." Dyer Environmental Controls, 2009. Web. 14 Dec. 2009. <http://www.dyerenvironmental.com/natural_vent_systems.html>.

"ODBC - PROJECTS." E.P.A.D.,(Technical equipment, art structure). ODBC, 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.odbc-paris.com/web/index.php?p=ref&mode=sel&&tri=&asc_desc=&page=1&numpp=20&type=&date=&pays=France&phare=&&id=74&n=17&id_cat=4&id_contenu=15>.

Patel, Mukund R. Wind and solar power systems. Boca Raton: CRC, 1999. Print.

"Pittsburgh, Pennsylvania (PA) profile. City-Data, 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.city-data.com/city/Pittsburgh-Pennsylvania.html>.

"Pittsburgh." Wikipedia, the free encyclopedia. 14 Dec. 2009. Web. 14 Dec. 2009. <http://en.wikipedia.org/wiki/Pittsburgh>.

Regan, Bob. The Bridges of Pittsburgh. Garden City: Local History Co., 2006. Print.
Riverlife West End Bridge Competition (mt). Web. 24 Sept. 2009. <http://www.riverlifecompetition.org/>.

Rivera, Dylan. "Cast your vote: Should new I-5 bridge design include wind turbines?" Oregonlive. The Oregonian, 13 Jan. 2009. Web. 14 Dec. 2009. <http://www.oregonlive.com/environment/index.ssf/2009/01/i5_wind_turbines.html>.

SAMYN and PARTNERS architects and engineers. 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.samynandpartners.be/>.

Sherwood, Roger. Housing Prototypes. 2002. Web. 14 Dec. 2009. <http://housingprototypes.org/>.

Sherwood, Roger. Modern Housing Prototypes (Harvard Paperbacks). New York: Harvard UP, 2002. Print.

Smith, Peter F. Architecture in a climate of change a guide to sustainable design. Oxford: Elsevier/Architectural, 2005. Print.

Stern. "Downtown: the current momentum in Pittsburgh's urban housing market should energize the rest of downtown as well." Urban land 65.5 (2006): 78-81. Print.

"Structural Awards." The Institution of Structural Engineers. IStructE, 14 Dec. 2009. Web. 14 Dec. 2009. <http://www.istructe.org/activities_events_awards/Pages/StructuralAwards.aspx>.

Tarr, Joel A. "The Metabolism of the Industrial City: the Case of Pittsburgh." Journal of Urban History 28 (2002): 511-545. 9 Oct. 2007 <http://juh.sagepub.com>.

Tukiainen, Matti. "Pittsburgh, Pennsylvania." Sunrise, sunset, dawn and dusk times around the World - Gaisma. Gaisma, 2009. Web. 14 Dec. 2009. <http://www.gaisma.com/en/location/pittsburgh-pennsylvania.html>.