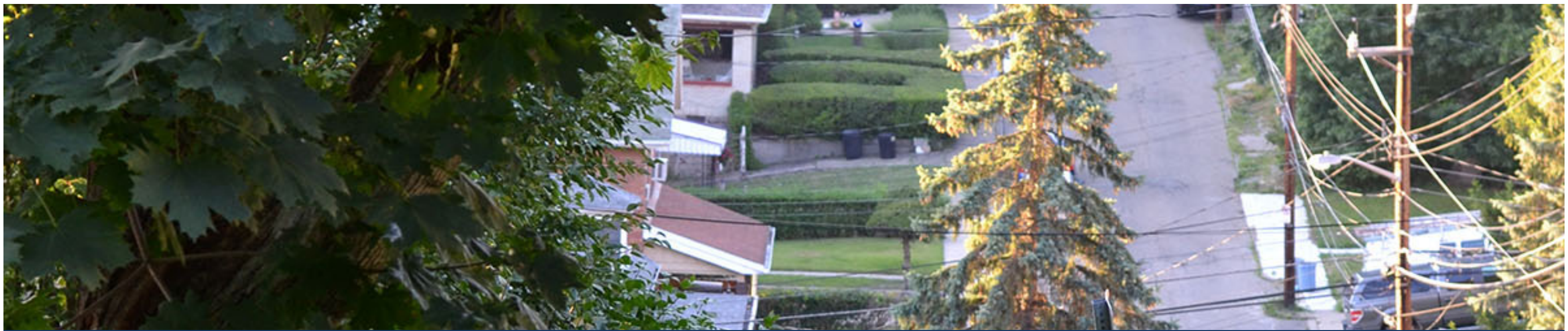


PITTSBURGH

Citywide Steps Assessment

CITY OF PITTSBURGH

Department of Mobility and Infrastructure

May 2018

PITTSBURGH

CITY OF PITTSBURGH
Department of Mobility and Infrastructure

TooleDesignGroup

Michael Baker
INTERNATIONAL

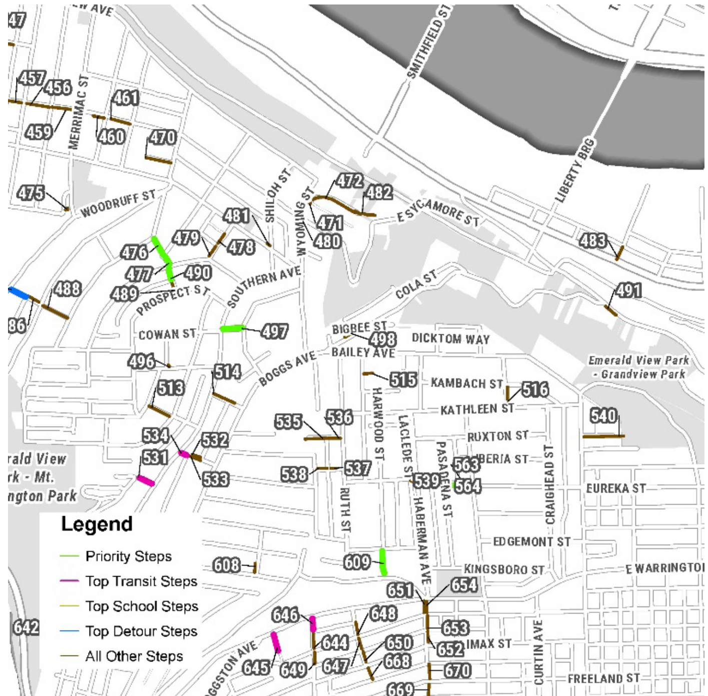
EXECUTIVE SUMMARY

Introduction

Pittsburgh has the most public staircases of any city in the United States. The more than 800 sets of city steps (with over 45,000 individual steps) connect communities and provide residents access to transit and other amenities. Nearly two-thirds of the steps are in low or moderate-income areas. The City typically repairs or replaces a few sets of steps each year.

The City has developed a systematic method for prioritizing which sets of steps should be repaired and rebuilt. The City used spatial analysis, public input, and field review to create a prioritized list of steps, and ultimately a list of step-related projects for rehabilitation and renovation in the next few years. The City also reviewed public step maintenance and repair best practices from other U.S. cities and developed guidance on step materials and design.

This report summarizes the process and findings of that effort.



One section of Pittsburgh steps map with priority steps labeled and color-coded.

Prioritization

The purpose of the prioritization process is to rank the City's steps according to their importance to the pedestrian transportation network. The prioritization is based on five factors:

1. Nearby destinations
2. Nearby population
3. Demographic factors, including walking rates, household poverty, and vehicle access
4. The amount of detour if the steps were absent
5. Density of steps nearby

This information was used to create four different prioritization scores to allow for comparison and analysis:

1. **Overall Score**—based on weighting of all factors (see full report for their relative weighting).
2. **Transit Score**—based on nearby bus and rail ridership, population, and the detour if the step were missing.
3. **School Access Score**—based on whether there is a nearby school, population, and detour.
4. **Detour Score**—based on the detour if the steps were absent.

See the map in the report appendix for the color-coded results.

The prioritization resulted in a list of 60 top scoring steps, which scored better than 90 percent of the steps. These steps are fairly evenly distributed between the South Side Slopes, Oakland, Greenfield, the Hill District, Troy Hill, and Fineview.

Five steps scored in the top tier in all five scoring categories. They were:

- Louisa St from Coltart Ave to McKee Place,
- Halpin St from Leipsic Way to Natchez St,
- Iowa St from Centre Ave to Ewart Dr,
- Chartiers Ave and Azalia St, and
- Zara St from Zara St to Beltzhoover Ave.

Outreach

The project team's approach to outreach was designed to provide as many opportunities as possible for community members to give input on individual staircases and shape the strategy for prioritizing steps for reconstruction and major rehabilitation. This included citywide public meetings, neighborhood meetings, an online interactive map and survey, social media outreach, and City Council briefings.

Participants at the citywide and neighborhood meetings provided feedback on several topics related to prioritization, improvements, materials, and design. For example, participants identified the two most important factors for prioritizing steps as "Access to destinations" and "Directness."

Eight hundred and twenty-three people completed 1,493 surveys about 469 different staircases by the close of the survey. A majority of respondents (54%) said they use a set of steps at least once a week. "Structural Deterioration" was identified as the most common obstacle to using city steps.

Input on Pittsburgh Steps Interactive Map Survey (WikiMap)

Best Practices

To compare Pittsburgh's step design, construction, maintenance, and community involvement methods to those of other cities, the project team interviewed city staff in Cincinnati, OH, Seattle, WA, and Portland, OR.

- All three cities build almost all on-grade concrete stairways, with a few built with steel.
- All three cities have determined concrete is the most cost-effective material for longevity and maintenance.
- Decommissioning: Seattle has decommissioned three stairways over the past two decades, citing lack of use as the primary reason for closure. Portland has decommissioned steps mainly for safety issues. Cincinnati decommissions public steps based on community request.
- Funding: Seattle's program is fully funded through the nine-year Transportation Levy to Move Seattle. Portland uses funding from their gas tax, funds from the PBOT, and from competitive federal funding sources. Cincinnati has not fully funded their Hillside Steps program since 2012.

Design and Materials

The material investigation revealed that steel has the highest cost of construction and the lowest lifecycle cost over a 75-year period due to its superior strength and estimated life span of 75 years. Wood has the lowest cost of construction, but is the costliest lifecycle option over a 75-year period due to its short lifespan and need for frequent replacement. Concrete - both precast and poured in place - has a lower cost of construction and a slightly higher lifecycle cost over a 75-year period than steel due to the need to fully replace it one time in the same time period. Though much weaker than steel, concrete provides a reliable alternative at a reasonable cost. Fiberglass, being a relatively new material, has not been tested extensively and is not recommended as a material generally. Fiberglass must be combined with either steel or concrete to function sufficiently. It is therefore best used as a material for steps repair.

Introduction

Pittsburgh has the most public staircases of any city in the United States. The steps connect communities and provide residents access to transit and other amenities. Nearly two-thirds of the steps are in low- or moderate-income areas and are critical assets in the city's pedestrian transportation network and beyond.

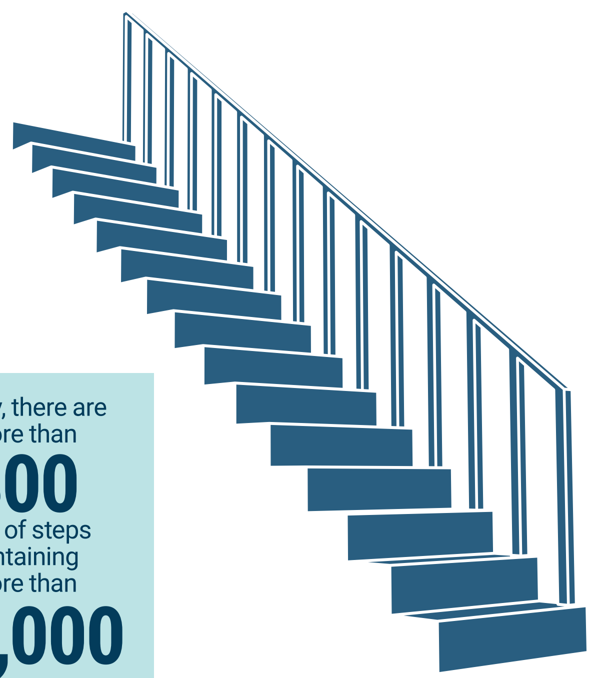
Today, Pittsburgh is a community of roughly 305,000 people, down from a peak population of about 670,000 in the 1950's. Changes in population, land use patterns, and employment centers have influenced the way that Pittsburgh's steps are used throughout the city. Many of Pittsburgh's residential neighborhoods are located on hilltops, or on hillsides. The "City Steps" that connect and serve these neighborhoods are a vital component to the mobility of residents, as well as to define the character and self-image of Pittsburgh's neighborhoods. The steps harken back to the City's industrial era, long before the ascendancy of the automobile or urban mass transit, when many more Pittsburghers walked to and from work, school, and other places of recreation, worship, and commerce. The steps provided critical links between the industrial and commercial development along the waterfront and the hillside residential areas.

The decline in Pittsburgh's population, along with a shrinking tax base, budget constraints, deindustrialization, deferred maintenance, and dis-investment have all contributed to the present deteriorated condition of many of the public staircases. Population shifts have rendered some staircases unused while some still provide critical connections for hillside residents. While the economic mix of the City has changed significantly, steps still provide a critical method of travel to work and home. In addition, many neighborhoods have organized their identity around the steps with yearly events, public art and lighting projects.

Maintaining the more than 800 sets of steps—containing more than 45,000 individual steps—is an enormous challenge. Approximately 450 sets of steps are built on structures, and repairing or replacing them is a logistical, design and construction undertaking comparable to a small bridge project. Additionally, approximately 350 are built into sidewalks, known as "jumpwalks." Suffering from fiscal and operational constraints, the City has taken on only a few staircase projects in the last few years.

In 2015, Pittsburgh Mayor William Peduto, issued two executive orders that influence the future of Pittsburgh's public staircases. In April, an Executive Order on Complete Streets Policy for Pittsburgh Rights of Way called for a holistic approach to urban mobility, including the staircases which are part of Pittsburgh's right-of-way network. In June, an Executive Order outlining the need for a Strategic Investment and Maintenance Plan for all City assets established the conditions, maintenance, and investment in City-owned infrastructure.

Managing and prioritizing step projects has been an enormous challenge for the city. The staircases are extremely well distributed throughout the city and there are very few steps known to have a higher amount of foot traffic than others. Many steps are hidden and it is difficult to know how often they are used or how important they are to the network without visiting each one, which the city has never had the capacity for. This plan quantified each staircase's value within the pedestrian network by looking at the surrounding street grid, land use patterns, population density, transit connections and used a public engagement process to validate those results and determine a course of action.



Today, there are more than
800
sets of steps containing more than
45,000
individual steps

Steps Prioritization

Purpose and Approach

The prioritization process was developed to rank the City's steps according to their importance to the pedestrian transportation network. Prioritization is based on several demographic and spatial factors. These factors were quantified to indicate the relative importance, in terms of mobility and access, of each set of steps.

To identify the factors associated with a particular set of steps, TDG developed a "walkshed" for each individual staircase by calculating the area accessible within a quarter-mile of the top and bottom of the step using the existing street network and other staircases.

Walkshed around Basin St Steps

Prioritization Factors

After developing the walksheds, the team analyzed five factors for each set of steps:

- Destinations
- Population
- Demographics, including pedestrian mode share, household poverty, and vehicle access
- Detour
- Step density

Census data was used for population and demographics, and the following section describes the method used to quantify the other factors.

Destinations

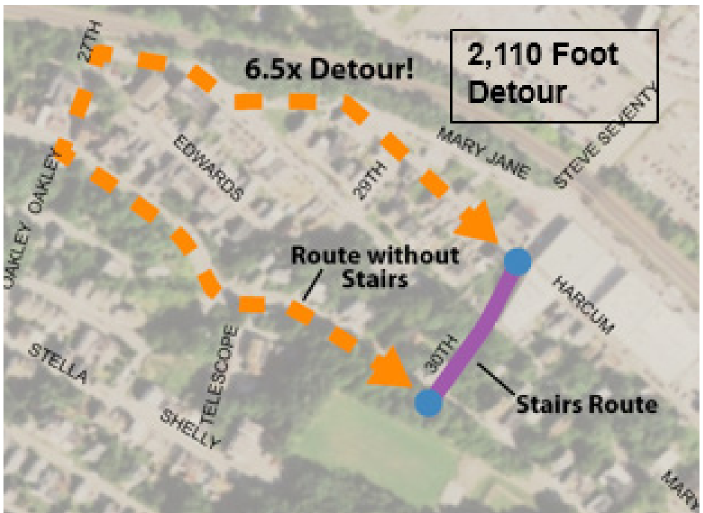
For each set of steps, TDG calculated the total number of the following destinations within the walkshed:

- Grocery stores
- Parks
- Libraries
- Hospitals
- Schools
- Universities
- Houses of worship
- Main street corridors
- Senior/Rec centers
- Public pools, and
- Other city attractions like government buildings, stadiums, etc.

Transit Ridership and Demographics

Additionally, within each walkshed, TDG calculated:

- Population
- Employment
- Rail transit boardings and alightings
- Bus boardings
- Pedestrian commute mode share
- Percentage of people without access to automobiles, and
- Household poverty rate



Detour Example

Step Detour

Another important analysis factor was the step detour. The step detour is defined as the distance a pedestrian would have to walk from the top to the bottom of a set of steps if that set of steps did not exist. This is a measure of that step's relative importance to the pedestrian network.

To include information on both the size of the detour relative to step length and the absolute detour length, the ratio of detour length to step length was multiplied by the detour length to create a detour score. Steps with a larger detour score are those that are more important to the pedestrian network. If they were removed or otherwise unusable, there would be greater inconvenience for step users.

Step Density

Areas of the city with more sets of steps, like the Southside Slopes, had smaller detour scores in general than other areas of the city with fewer steps (because if one step was removed a nearby step could be used, minimizing the detour). For this reason, TDG developed a step density score to make sure communities where steps are a commonplace part of the transportation network received adequate attention in the step prioritization process. The step density score was calculated by creating a heatmap of all steps citywide and extracting the average score for each step walkshed.

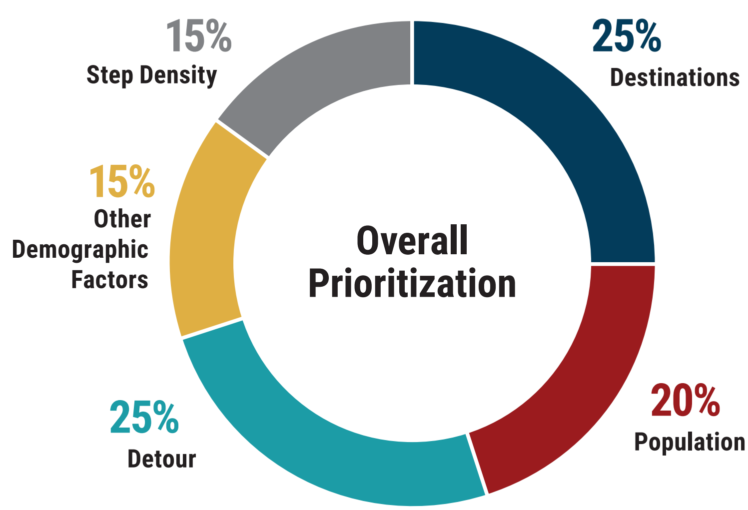
TDG sorted each step's factor scores into deciles. TDG then scaled the factor scores to make them comparable to one another. The weight described below was applied to each factor to develop overall prioritization scores.

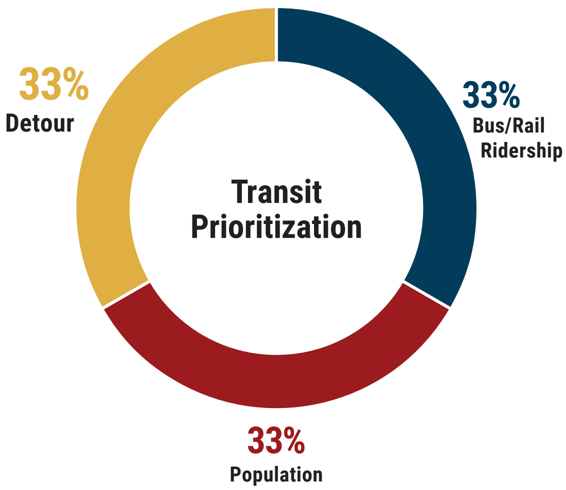
Analysis and Results

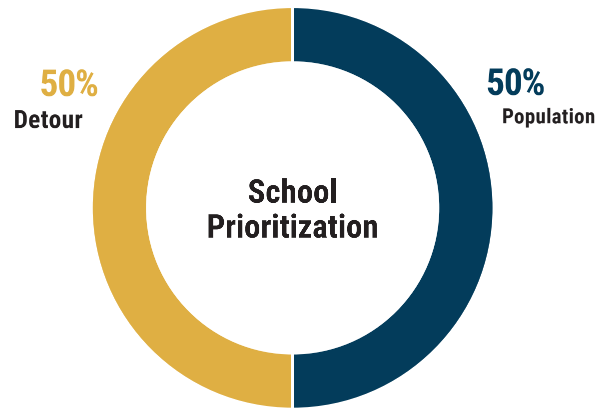
Factor Weights

Recognizing that some factors are more important than others, each of the factors was assigned a "weight." The factor weights used in the overall prioritization formula are:

- Destinations (25%)
- Population (20%)
- Other demographic factors, including pedestrian mode share, household poverty, and vehicle access (15%)
- Detour (25%)
- Step density (15%)







Destinations were broken down further into more major destinations (employment, rail and bus ridership, and grocery stores) weighted 70 percent and other destinations (pools, libraries, hospitals, universities, senior/rec centers, parks, houses of worship, and other city attractions) weighted 30 percent.

In addition to the overall prioritization, TDG conducted three other analyses to identify projects that should be prioritized for specific funding sources. To identify steps well-suited for specific transit-access grant funding, TDG developed a transit prioritization with the following elements:

- Bus and rail ridership (33.33%)
- Population (33.33%)
- Detour (33.33%)

To identify steps well-suited for Safe Routes to School and other school-focused funding sources, TDG developed a school prioritization with the following elements:

- Step walkshed must include at least one school
- Population (50%)
- Detour (50%)

The detour score was also reported for each step to allow for a detour-only ranking.

Top Ranking Steps

TDG sorted each of the prioritization scores into deciles and identified steps in the 90th percentile for the overall prioritization, the transit prioritization, the school prioritization, and detour-only prioritization. Steps in the 90th percentile scored better than 90 percent of steps citywide.

TDG then created a map to show the steps in the 90th percentile in each category.

Step prioritization in this document is based on the Project Team's data analysis described earlier. City staff will work closely with community members to further refine step priorities and identify which steps should be reconstructed first and create a project list.

Results

There are 60 steps in the 90th percentile in the overall prioritization. These steps are fairly evenly distributed between the South Side Slopes, Oakland, Greenfield, the Hill District, Troy Hill, and Fineview. Of these steps, five score in the 90th percentile for all four prioritizations. They are:

- Louisa St from Coltart Ave to McKee Place,
- Halpin St from Leipsic Way to Natchez St,
- Iowa St from Centre Ave to Ewart Dr,
- Chartiers Ave and Azalia St, and
- Zara St from Zara St to Beltzhoover Ave.

Of these steps, 37 also score in the 90th percentile for the transit prioritization. Sixteen also score in the 90th percentile for the school prioritization, and 14 also score in the 90th percentile for detour prioritization.

There are 40 steps in the 90th percentile in the transit prioritization that are not in the overall prioritization. Many of these steps are in Beechview and Mt. Oliver. There are four steps that are in the 90th percentile of the transit and school prioritizations but not the overall prioritization. They are:

- Linden Lane from Wilkins Ave
- Murdoch Rd from Hobart St to Gaurino Rd
- Wapello St from Benton Ave to West Pointe Ave, and
- Martha St from Kalamazoo Way to Duffield St.

There are seven steps in the 90th percentile for transit and detour prioritizations. They are:

- Overbrook Blvd and Saw Mill Run to Dartmore St,
- Dewitt St from Southern Ave to Griffin St,
- Second Ave at Armstrong Tunnel to Bluff St,
- Ottawa St from Penelope St to Southern Ave,
- Hobson St from Breining St,
- Brighton Heights Blvd and La Porte St to Verona Blvd, and
- Murdoch Rd from Hobart St to Gaurino Rd scores in the 90th percentile for transit, school, and detour prioritizations.

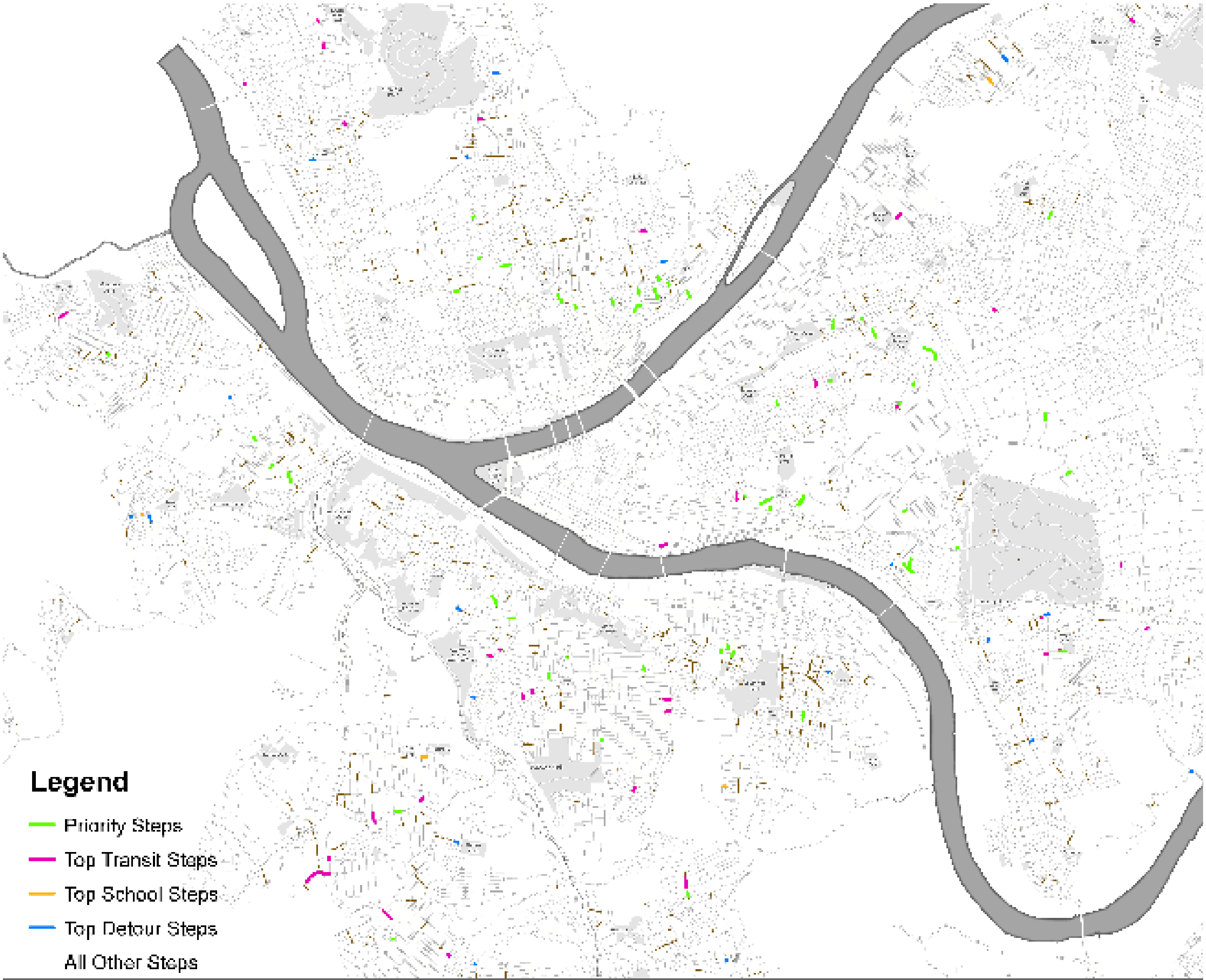
There are four steps that are in the 90th percentile for the school prioritization but not in the transit or overall prioritizations. They are:

- Fisher St from Otillia St to Gorgas St,
- 54th St from Wickliff St to Camelia St,
- Stratmore Ave and Crafton Blvd to Clearview Ave, and
- Andick Way from Westfield St to Rockland Ave

Of those, Stratmore Ave and Crafton Blvd to Clearview Ave is also in the 90th percentile for detour.

There are 19 steps in the 90th percentile for detour that are not in the 90th percentile for the other three prioritizations.

Please refer to the map and table in the appendix for a more detailed breakdown of step priorities.



Overall city steps map

Public Outreach

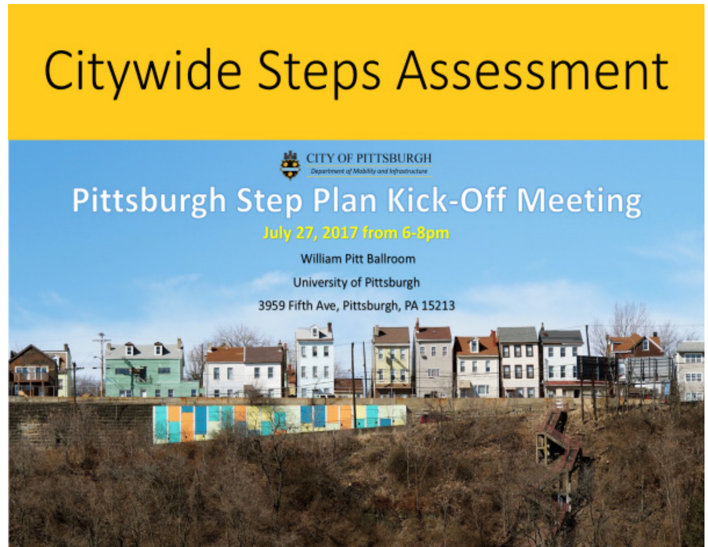
Background

In 2014, City Planning was tasked with conducting a city-wide steps assessment using summer intern staff to collect data on each staircase's condition and take photos. Given the large number of staircases spread out over a 55 square-mile city, this was a slow task even with an army of summer interns eager to get outside. To speed things up, the city set up a call for volunteers and planned to train groups to collect data on their own.

The love and commitment that Pittsburghers have for their steps was abundantly clear when three hundred people signed up within the first day to volunteer for the steps count. This passion is also evident in the many events centered on the public staircases throughout the city, the signed walking routes planned and funded by community groups and the residents who show up to capital budget meetings organized in T-shirts declaring support for the maintenance and repair of the public steps.

Individuals and community groups have continued to express significant interest in the City's more than 800 staircases as critical transportation assets and part of their neighborhood and civic identity. Public outreach is central to the Pittsburgh Citywide Steps Assessment. The section summarizes initial public feedback, and feedback collected at the first public meeting, neighborhood meetings, and through the online WikiMap survey. The accompanying appendices contain more detailed information regarding the outreach tools and results.

Welcome slide from the July 27 Citywide kickoff meeting. Screen capture of a tweet from @BikePedPGH promoting the City Steps Survey WikiMap. The WikiMap has had 823 users comment on 469 steps by Wikimap close on October 16th, 2017.



Introductory slide for the first public meeting

Approach to Outreach

The project team's approach to outreach was designed to provide as many opportunities as possible for community members to give input on individual staircases and shape the strategy for prioritizing steps for reconstruction and major rehabilitation. This included citywide public meetings, neighborhood meetings, an online interactive map and survey, social media outreach, and City Council briefings.

By the end of the project, two citywide meetings were held: the kickoff meeting, which took place in July, and a follow-up meeting in 2018 to share project findings.

In addition, the City solicited feedback on public steps during 11 neighborhood meetings across Pittsburgh.

Mass emails and social media messages about the project were sent through the Office of Community Affairs and Neighborhood Planners. This included promotion of an online interactive map, or WikiMap, and survey (see above). The interactive WikiMap and survey gave members of the community the opportunity to note frequently used steps and those that need improvement. When the survey closed on October 16th, 823 people had completed 1493 surveys on about 469 steps.

The project team also held a briefing for City Council members in advance of the first citywide public meeting. The Council members encouraged the team reach out to communities that may have been historically overlooked as well as those neighborhoods without a traditional association with staircases.

Findings: Citywide Meetings

On July 27, 2017 from 6:00-8:00pm at the William Pitt Ballroom at the University of Pittsburgh, the team held the Citywide Steps Assessment Kickoff public meeting. The purpose of the meeting was to introduce the community to the project; to gauge the public's appetite for investing in the City's steps; and to solicit input on the community's priorities for individual steps, overall criteria for evaluating the importance of steps, and preferences regarding materials used for step rehabilitation and reconstruction.

The team learned that there is significant enthusiasm for this project and for the maintenance and repair of the City's steps. There was support voiced for increased maintenance and repair, public art, better lighting, programming to bring people to use the steps, and landscaping.

One of the feedback stations at the meeting asked participants for input on how to prioritize steps for repair, upgrade, and potential future decommissioning. According to participants, the key factors for prioritizing steps were "access to destinations," "directness," and "cultural significance." This feedback was incorporated into the steps prioritization process. Access to destinations and directness are highly weighted factors in the system. The City and project team are working on ways to incorporate cultural significance into the prioritization.

The full presentation slides, meeting boards, and feedback received can be found in the appendices.

Which Factors are Most Important in Weighting Step Priority?

Factor	Count	Percentage
Access to destinations	45	25%
Directness	39	21%
Cultural significance	35	19%
Usage	28	15%
User safety	9	5%
Other	27	15%
Total Count	**183**	

"Pittsburgh's city steps are part of the fabric and the imagination of this town. Like the bridges, the stairs represent connectivity, but on a smaller, more intimate level."

– Public Comment

Public Feedback

Opportunities for the City Steps...

"Allow groups to install historic markers for a small fee."

"Adopt-a-step program to assure on-going maintenance"

"Creative lighting solutions and opportunities for artwork & mosaics!"

"There is already the 'Doors of Ireland' why not the 'Steps of PGH'"

Participants at the Citywide Steps Assessment Kickoff Public Meeting complete the WikiMap survey, respond to the meeting boards, and discuss the important of the City steps.

How can steps be improved?

Improvement	Count	Percentage
Structural Condition	87	43%
Maintenance	42	21%
Lighting	26	13%
Safety	23	11%
Signage	15	7%
Other	10	5%

Participants at the July 27th Citywide Steps Assessment Kickoff Public Meeting identify city steps that are important to the pedestrian network. In the background, a participant places comments on a meeting board to provide input on how community groups and individuals can get involved in maintaining city steps.

What Are Your Priorities for Materials and Design?

Tread

Type	Count
Open decking	26
Closed tread	18
Non-slippy	13
As appropriate to individual location	2
Softer surface	1

Railing

Type	Count
I'd like to see more color	25
Open sides	19
Natural materials	0
Closed sides	0

Structure

Type	Count
Whatever is the most cost-effective	36
Concrete	12
Steel	6
Wood	1

Public Feedback

Other Material and Design Considerations

"[Prioritize] historical preservation of the originals"

"Bikes should be accommodated on every project (wheel ramps)"

"Railing should hold my weight and not injure me if I slip"

"[Make the] smartest investment over lifetime of the materials"

"In a natural setting use wood"

"No wood!! Slippery in rain, ice, and snow"

Findings: Neighborhood Meetings

City representatives attended 11 standing neighborhood meetings to present an overview of the project and hear more from the community about how they use the steps and how they would like to see them improved (See the meeting schedule to the right.) City representatives brought iPads to the meeting to demonstrate the WikiMap and flyers with the project website address. Attendees were encouraged to complete the WikiMap survey to provide input on the steps that are important to them.

One of the questions that has come up frequently is about the role of the community in improving the city steps. During the citywide meeting, participants noted that the community has a role to play in advocating for the repair of the steps, alerting the city to issues with the steps, "adopting" steps, monitoring safety, volunteering, and fundraising.

A short questionnaire was sent to neighborhood groups post-meeting to gauge community interest in caring for city steps. Most responses confirmed that residents are interested in participating in art and landscaping for beautification. Respondents also showed an equal interest in assisting with brush and snow removal and light repairs. Some respondents did reply that beautification and maintenance projects should be the city's responsibility. The city is considering opportunities to increase participation in step stewardship and maintenance for residents and community groups who want to take an active role in caring for city steps.

Public Feedback

The Community's Role in City Steps Is…

"Stewardship is the first line of maintenance. Report issues to be handled by city works."

"To participate in weeding, clean-ups, and lighting or art projects"

"Develop programs (i.e. step challenge, etc.) to encourage use"

Neighborhood Meeting Schedule

August 7th: Greenfield Community Association's Development and Transportation Committee, 521 Greenfield Ave. at 7:00pm

August 16th: Observatory Hill Inc., 3505 Perrysville Avenue at 7:00pm

August 17th: Mount Washington Community Forum, 122 Virginia Avenue at 6:30pm

August 17th: Beltzhoover Consensus Group Forum, 900 Delmont Ave at 6:30pm

August 22nd: Bloomfield Livable Streets, 4754 Liberty Avenue at 6pm

September 5th: Polish Hill Civic Association Steps Meeting, 450 30th Street at 6:30pm

September 11th: Spring Hill Civic League, Spring Hill Elementary School at 6:00pm

September 12th: Community Alliance of Spring Garden and East Deutschtown, 1308 Spring Garden Avenue at 6:30pm

September 14th: Oakland Green Team, 294 Semple Street at 6:00pm

Findings: Wikimap Results

As noted above, 823 people completed 1,493 surveys about 469 different staircases by the close of the survey. The neighborhoods with most comments in the WikiMap were Upper Lawrenceville, Morningside, Southside Slopes, and Beechview. The steps with the most comments were "Joncaire St at Isis Way to Frick Art Museum," "Downing St from Herron Ave to Hancock St," and "Martha St from Duffield St to El Paso St."

Steps with the most comments

The 21 steps that received more than 10 completed survey responses

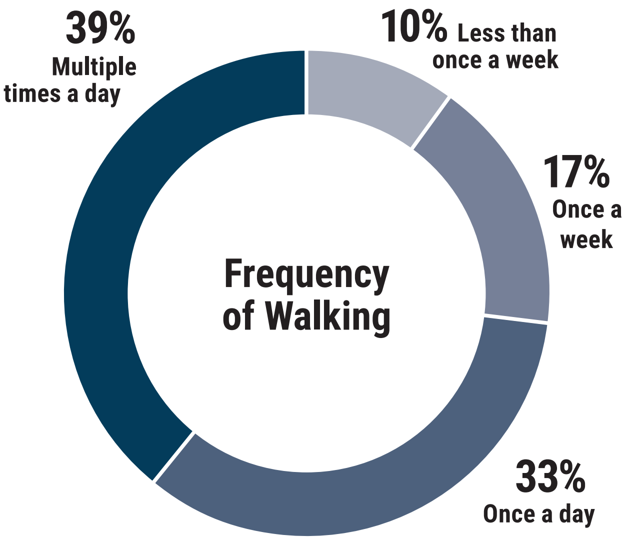
Step	Surveys
Joncaire St at Isis Way to Frick Art Museum	25
Downing St from Herron Ave to Hancock St	22
Martha St from Duffield St to El Paso St	22
Rialto St to Lowrie St	21
56th St from Carnegie St to Duncan St	21
Winterburn Ave from Coyne Terrace	20
S 18th St near Josephine St to Pius St	16
Stanton Ave to McCandless Ave	15
S 18th St and Mission St to S 21st	14
Murray Ave at Beechwood Blvd	14
Vinecliffe St to Wyoming St	14
Sterling St from Mission St to Patterson St	13
Gallatin St from Baker St to Witherspoon St	13
57th St from Christopher St to Duncan St	13
Devon Rd and Warrick Terrace from 5th Ave	12
57th St from Duncan St	12
End of Lilac St to Rosemoor St	12
Loretto St from McCaslin St to Tesla St	12
Harding St from Herron Ave to Dobson St	12
Sterling St from Greeley St to Leticoe St	12
54th St from Wickliff to Camelia St	11

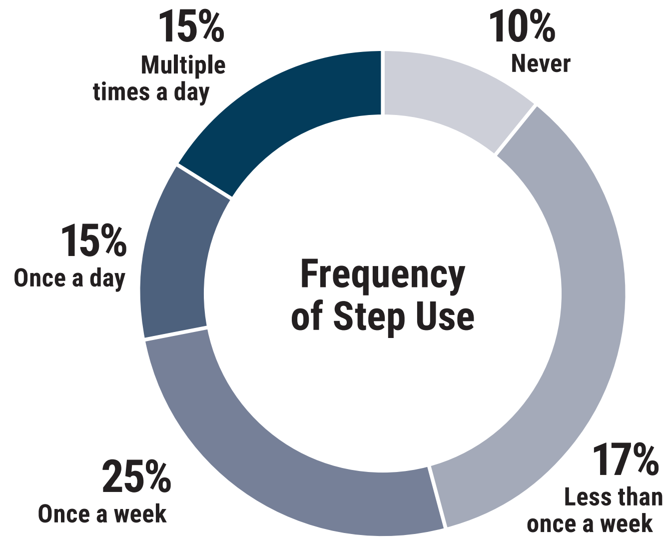
A majority of respondents (54%) said they use a set of steps at least once a week. Only 11% said they never use the steps. The most common reasons to use the steps were for exercise, to access transit, to go to work, and to shop. It is not clear from the survey results if "exercise" is the whole reason for the trip, or the reason for choosing to walk rather than take another mode, or the reason for selecting a route that includes a staircase rather than a walking route that did not—or some combination. In any event, the survey results show that people make a clear connection between using steps and exercise.

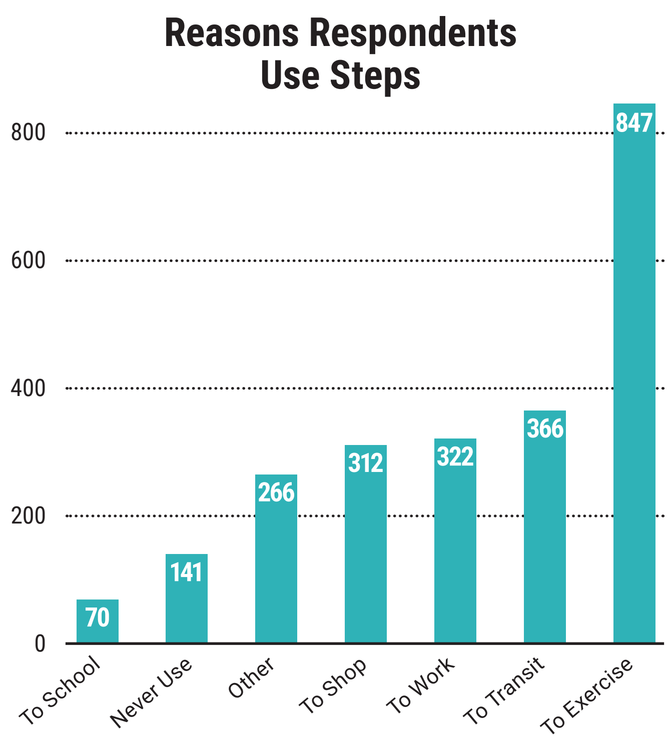
The most common obstacles identified were structural deterioration, overgrown vegetation, poor lighting, loitering, and illegal dumping. The third most popular overall answer, however, was that the staircase had "no obstacles" to use. This shows that there are a range of conditions on the City's steps. Step-specific surveys asked the respondent to rate the condition of the step from very poor to excellent. Since many steps were rated by multiple respondents, this analysis reports the most common rating for each step. A majority (55%, 259 steps) were said to be in "good" condition, and 32 percent (152 steps) were rated "fair." Thirty-seven steps (8%) were rated poor or very poor.

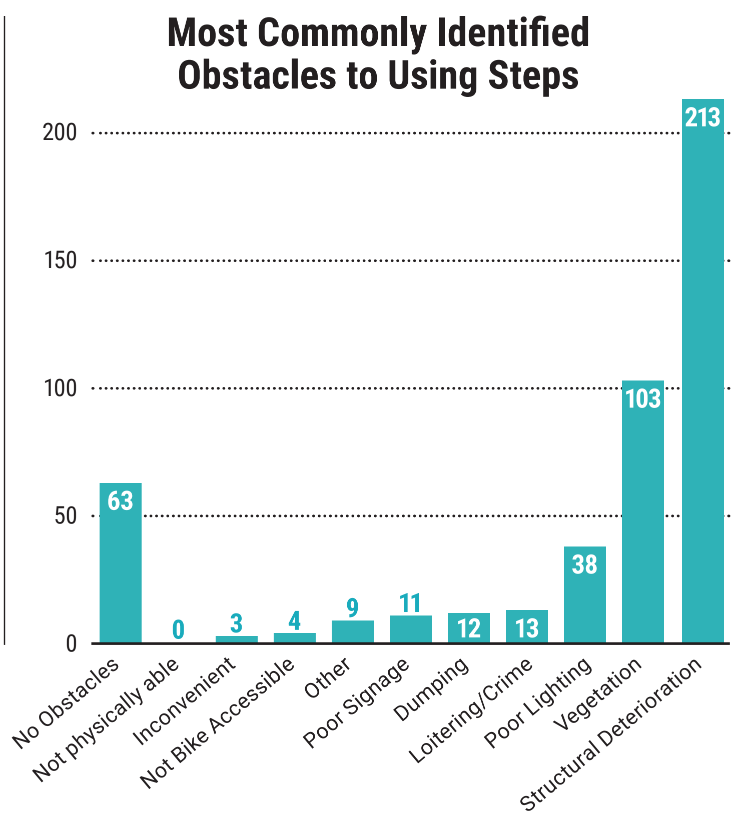
The appendix contains more details on the WikiMap results, including a chart of the dates on which the most comments were received.

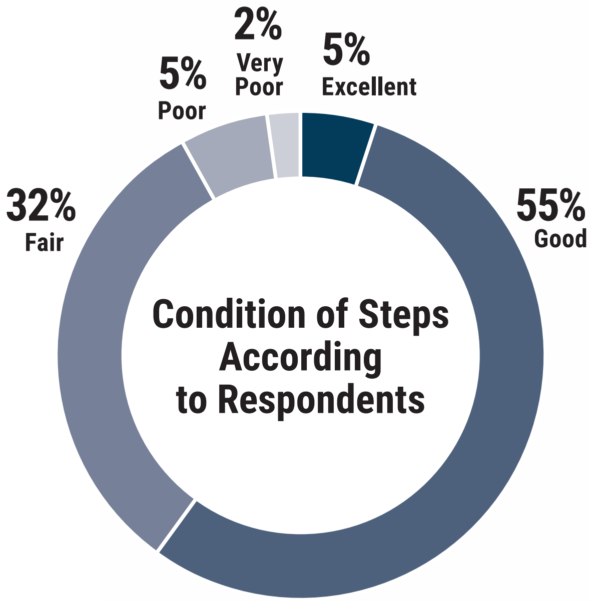
WikiMap Survey Results



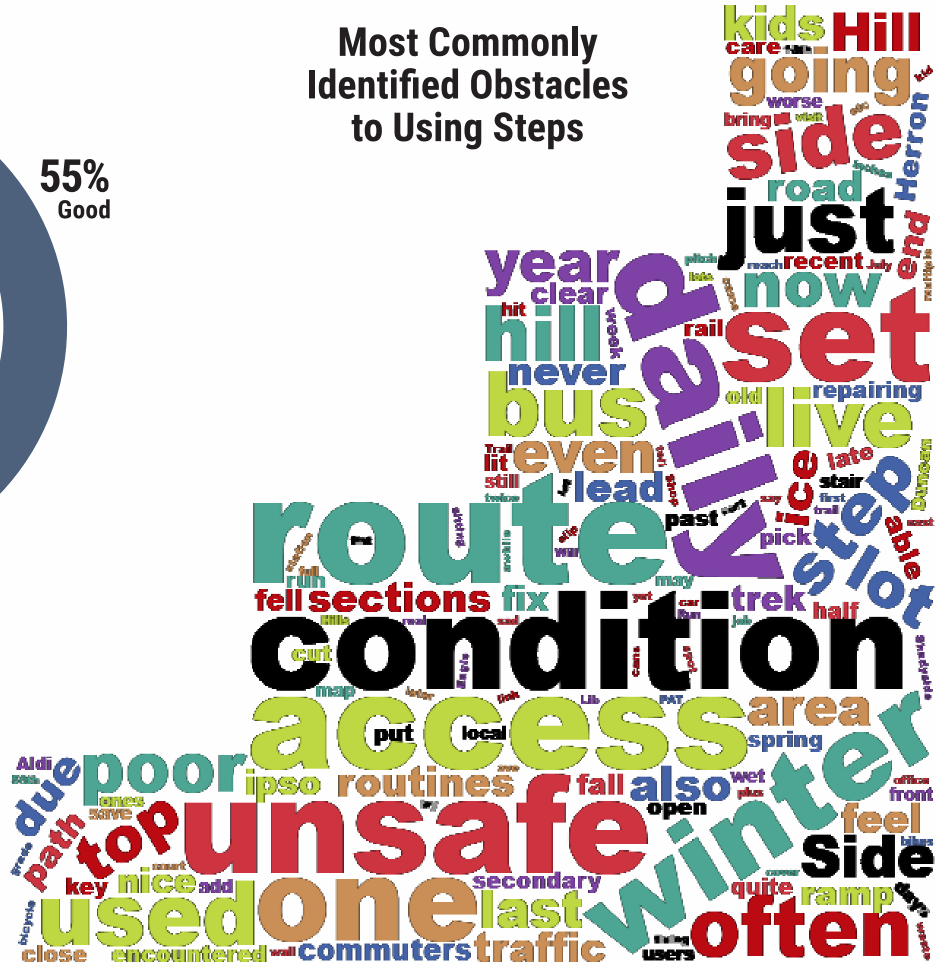








Most Commonly Identified Obstacles to Using Steps

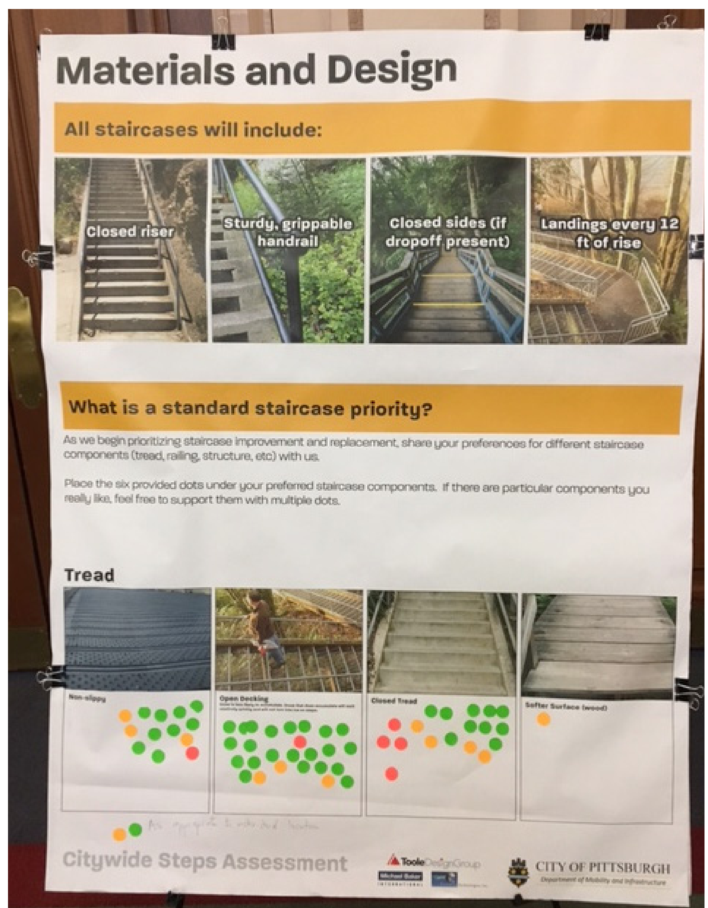


Summary

In general, the public outreach process confirms that community members in Pittsburgh are committed to their steps. Participants were sensitive to the cost of repairing and rebuilding steps and interested in finding creative ways to support the goal of maintaining a safe and useful system of public steps. The specific feedback on priorities informed the weighting of the prioritization system, and the feedback about the role of the community will inform City-organized programs in subsequent project phases.

A public meeting participant notes which steps she uses most frequently and which need improvement.

Responses to part of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis public meeting station.



Responses to a public meeting board where participants stated a preference for various materials and designs.

Best Practices:
Public Steps Programs in Cincinnati, Portland, and Seattle

In order to compare Pittsburgh's methods of steps design, construction, maintenance, and community involvement with the similar practices of other cities, the project team completed a series of interviews with geographically-similar cities across the United States. Using a standardized survey, they determined the best practices employed in Cincinnati, OH, Portland, OR, and Seattle, WA.

Methodology

These cities were selected from a list of cities with public steps. The final list of selected cities included: Brookline, MA, Philadelphia, PA, Montreal, Quebec, Cincinnati, OH, Seattle, WA, Portland, OR, and San Francisco, CA. Additionally, the team drafted and revised survey questions used to keep the interviews concise and targeted. The survey questions may be found in the appendix.

Oakley Street Steps to South Side Slopes, Pittsburgh

The consultants made preliminary calls to relevant departments, including transportation, public works, and planning, across the seven selected cities to find the appropriate staff members to interview and to schedule the interview itself. After three weeks of contact, the consultants were able to interview Seattle, Portland, and Cincinnati. The results of those interviews are in the following section organized by category. Full interview notes can be found in the appendix.

Comparison Demographics

Pittsburgh, PA

Population (2016): 303,625

Density: 5,423 people/sq. mi.

Steps: 700 +

Cincinnati, OH

Population (2016): 298,800

Density: 3,810 people/sq. mi.

Steps: ~ 400

Portland, OR

Population (2016): 639,863

Density: 4,375 people/sq. mi.

Steps: ~ 200

Seattle, WA

Population (2016): 704,352

Density: 8,398 people/sq. mi.

Steps: 500 +

Findings

Programming

All three cities run their steps programs within their respective departments of transportation: the Seattle Department of Transportation (SDOT), the Portland Bureau of Transportation (PBOT), and Cincinnati Transportation and Engineering. Each program is managed by a single person who coordinates efforts among other planning and construction staff in outside departments.

SDOT and Cincinnati Transportation and Engineering break out steps into their own program (Stairway Maintenance program and Hillside Steps program, respectively). PBOT groups steps into their Engineering and Structures program under the belief that stairways should not be separated from sidewalks.

Seattle's program plans on replacing every stairway by 2024, but prioritizes the replacements by usage collected through public survey. An initial, city-wide survey has guided them through the prioritization process, but that list is updated yearly through additional surveys. Portland's program is repairing stairways as needed and will plan and prioritize locations of new stairways once new stairway designs are implemented. Cincinnati has a list of maintenance priorities developed when it was last fully funded.

Stairway to Summit Avenue in Portland, OR. Flickr user: brx0

Funding

Seattle's program is fully funded through the Transportation Levy to Move Seattle.[1] The nine-year tax levy closes the gap on transportation infrastructure programs and enables the Stairway Maintenance program to operate without seeking federal grants and fully meet their goals.

PBOT's Engineering and Structures program receives funding from their jurisdiction's gas tax, funds from the PBOT, and from competitive federal funding sources.

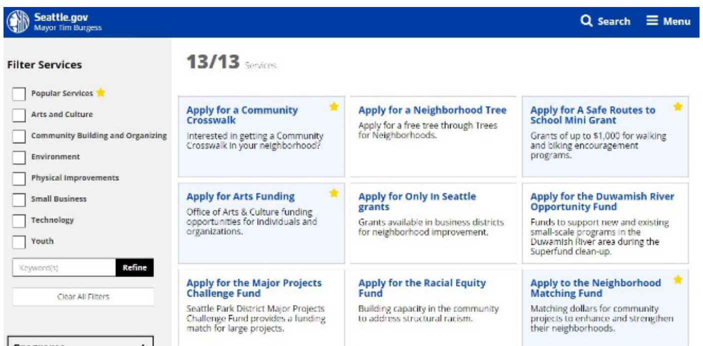
Cincinnati has not fully funded their Hillside Steps program since 2012. This has resulted in minimal construction and maintenance since that year. Much of the program's available funds (ranging from $0-30K/year from the Capital Improvement Plan and maintenance budgets) go to the replacement of steel railings which have been stolen and sold for scrap metal.

1 The Transportation Levy to Move Seattle https://www.seattle.gov/transportation/levytomoveseattle.htm

Community Roles

SDOT had the most aggressive participation program, including funded staff members. Believing that public engagement is key, SDOT brings the community in from the beginning. Users of stairways are notified of future maintenance a year in advance through the installation of kiosks at the top and bottom of the stairway (example flyer available in appendix). These kiosks feature project information and a link to an online survey for public input. For neighborhoods that are more heavily involved in maintaining their public infrastructure, SDOT has taken the guess work out of the grant process. With a website offering a list of relevant grant opportunities ranging from the local to the national level, Seattle citizens can find all the information they need to apply, and are connected to city staff familiar with the grants via email. These grants can cover services SDOT does not offer with regular stairway maintenance, including more frequent clean ups and landscaping.[2]

Seattle stairway kiosk. http://www.seattle.gov/transportation/images/stairwayletterbox.jpg



Screenshot of Seattle's grants and funding assistance website.

SW Edmonds Street Stairway in Seattle, WA
Flickr User: SDOT Photos https://www.flickr.com/photos/sdot_photos/19947139582/in/photostream/

Because of budget constraints, PBOT focuses on repairs and a once-a-year clean-up. This has prompted community groups to take action for stairway maintenance. One neighborhood improvement non-profit, Southwest Trails PDX, fundraises and improves public areas in its vicinity. The city hopes to build upon the achievements of this non-profit and add needed amenities to these selected stairways.

Budget constraints also prevent Cincinnati from landscaping and frequent clean-up projects. This condition, similar to Portland's, has resulted in Bloc Ministries in Cincinnati's Lower Price Hill taking ownership of the steps nearby. Unfortunately, high crime and perceived danger have led the community to request closures of steps more often than taking ownership of them.

2 Seattle Grants and Funding Information Service http://www.seattle.gov/services-and-information/grants-and-funding

Decommissioning

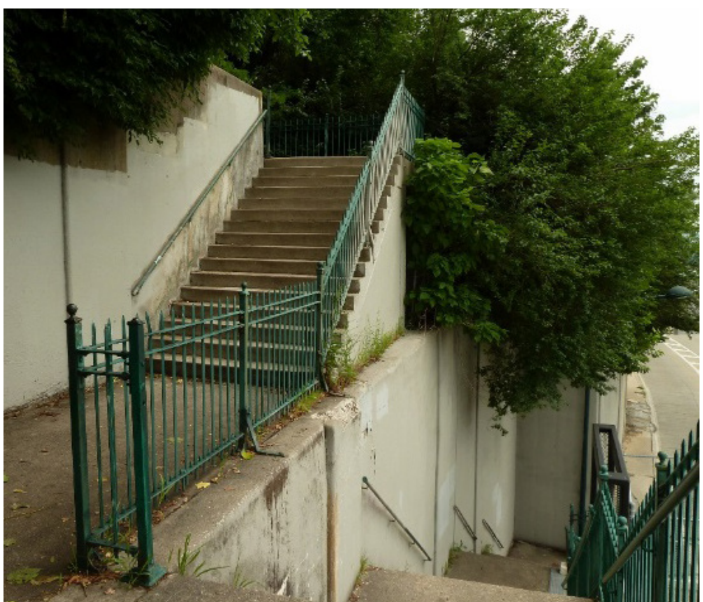
Seattle has decommissioned three stairways over the past two decades, citing lack of use as the primary reason for closure. These stairways are in remote areas and may have once led to homes and jobs, but are no longer an active part of the transportation network. Seattle's decommissioned stairways are blocked off, but not demolished.

Portland has decommissioned steps mainly for safety issues. Some stairways descend into tunnels built under major streets. These dark and secluded areas have become areas of criminal activity and are being sealed off, resulting in the closure of the stairway as well. These tunnels all have street crossings above.

Cincinnati decommissions public steps based on community request. These requests are the result of actual and perceived criminal activity occurring on the stairways. Once the decommissioning is requested, the planning department and city council must approve the request. Decommissioned steps are removed and the right-of-way is sold.

Design and Materials

All three cities build almost exclusively on-grade concrete stairways. In certain situations, these cities deviate from the preferred concrete on-grade stairways. In a heavily wooded test site, Seattle constructed a composite wood and plastic stairway, which is currently warping. The city plans to construct two steel stairways on a hillside prone to land-slippage. This condition also prompts Portland to use metal structures.



Stairway to Oregon Street in Cincinnati, OH
http://www.gentleartofwandering.com/stair-wandering-in-cincinnati/

"We build to a 70-year standard.
Only concrete can get us there on budget."

– Greg Funk, SDOT

All three cities have determined concrete is the most cost-effective material for longevity and maintenance. Seattle builds to a 70-year standard and can only achieve that while staying on budget through the use of concrete. By their estimate, a run of on-grade stairs between 100' to 140' costs them $150,000-$170,000.

None of the three cities have yet to consider using fiberglass.

Steps standards can be found in the appendix.

Americans with Disabilities Act (ADA)

All three cities spoke of ADA compliance in terms of closed treads and compliant handrail standards.

Seattle's program is fully funded, enabling them to replace every stairway in the city over two decades. All new stairways are built to ADA standards meaning that by 2024, all stairways in Seattle will be ADA compliant.

Portland is not currently constructing stairways due to ADA interpretive disagreements. When the city updates its design guidelines, PBOT hopes to start constructing new stairways as needed and with an agreed-upon degree of ADA compliance. For existing stairways, the city will rehabilitate stairways to ADA standards by request.

Although rare, new stairways in Cincinnati have ADA compliance considerations in their designs. All existing stairways have closed treads.

ADA stairway requirements can be found in the appendix.

"Don't build substandard stairs… You can't know what future development may occur."

–Cameron Glasgow, PBOT

Construction

Seattle puts a small fraction of work out to bid. Over the past decade due to the Transportation Levy to Move Seattle and its predecessor, Bridging the Gap, SDOT has added enough skilled workers to complete infrastructure improvements in house.

Portland is required by state law to put any project over $120,000 out for bid. All other work is completed by the PBOT.

Cincinnati sends major projects out for bid. Lesser projects are completed by the Transportation Roadway Operation Division (TROD).

Advice for Pittsburgh

Both Seattle and Portland provided some advice for Pittsburgh's future steps construction. As two of America's foremost bike-friendly cities, Seattle and Portland stressed the importance of bicycle runnels (gutters that allow cyclists to wheel their bikes up a stairway). Both cities are implementing bike runnels in highly populated areas. However, Portland stressed the need to think ahead of existing population density. Having a sense of what could develop around a staircase means no staircase should be underbuilt. Apart from runnels and future population, Portland reminded the interviewers that lighting should be a top priority.

Design Guidelines and Material Investigation

This section provides the strengths, weaknesses, and special considerations for the use of steel, concrete, fiberglass and wood in steps design and construction. It also includes code requirements related to step design and construction as of December 2017 under the International Building Code (IBC), the American National Standards Institute (ANSI), and the Americans with Disabilities Act. Lastly, this section includes cost estimates for the construction and lifecycle of steps built with different materials.

The results of the material investigation reveal that steel has the highest cost of construction and the lowest lifecycle cost (over a 75-year period) due to its superior strength and estimated life span of 75 years. Wood has the lowest cost of construction, but is the costliest lifecycle option (over a 75-year period) due to its short lifespan and need for frequent replacement. Concrete—both precast and poured in place—has a lower cost of construction and a slightly higher lifecycle cost (over a 75-year period) than steel due to the need to fully replace it one time in the same time period. Though much weaker than steel, concrete provides a reliable alternative at a reasonable cost. Fiberglass, being a relatively new material, has not been tested extensively and is not recommended as a material generally. Fiberglass must be combined with either steel or concrete to function sufficiently. It is therefore best used as a material for steps repair.

1. Design Guidelines

As the city with the most public stairways in the world, the City of Pittsburgh is committed to maintaining this unique element of its transportation network to high standards, specifically with respect to:

1. **Safety:** building and repairing steps that minimize user injury
2. **Aesthetics:** building and maintaining steps that appear safe and inviting
3. **Cost efficiency:** building and maintaining steps with materials that will provide the most durability over time without resulting in prohibitive costs
4. **Accessibility:** building and rehabilitating to designs that consider the needs of users with disabilities

In order to achieve these standards, architecture, engineering, and planning consultants at Michael Baker International, Cosmos Technologies, and Toole Design Group completed a steps materials and construction investigation, and developed design guidelines for the City of Pittsburgh public stairways (steps).

1.1. Definitions of Stair Components

Guards

Guards are located at the side edges of the stairs and are a code-required construction structure needed to prevent users from falling off the stairs. They are usually made of the same material as the handrails.

Handrails

Handrails are located inboard of the guards and are needed on both sides of the stairs.

Landings

Landings are a horizontal portion of the stairs located between flights to allow users to rest between segments of stairs.

Treads

Treads are the horizontal portion of a step that is walked on. The nose of the tread is the front edge.

Risers

Risers are the vertical portion of a step that connects each tread.

1.2. Best Practices

As part of the wider City Steps Initiative, Michael Baker International urban planning consultants on the Toole Design Group Team prepared a nation-wide best practices report comparing steps construction and maintenance programs in Cincinnati, Portland, and Seattle. Major findings from that research are:

- Nearly all steps in the three cities' inventories were concrete, on-grade stairways.
- All stairway programs were part of local transportation departments.
- None of the cities were considering the use of fiberglass - a material investigated within this investigation.

In certain situations, these cities deviate from the preferred concrete on-grade stairways. In a heavily wooded test site, Seattle constructed a composite wood and plastic stairway, which is currently warping earlier than lifecycle expectations. The city plans to construct two steel stairways on a hillside prone to land-slippage. Landslides also prompt Portland to use metal structures.

All the subject cities determined that concrete is the most cost-effective material for longevity and maintenance. Seattle builds to a 70-year standard and can only achieve that while staying on budget using concrete. By their estimate, a run of on-grade stairs between 100 feet to 140 feet costs approximately $150,000-$170,000.

None of the cities contacted have yet to consider using fiberglass. Additional findings from the best practices research can be found in the best practices chapter.


Concrete stairway in Seattle

1.3. Accessible Conditions and Requirements

This section includes the code requirements in place for public stairways, defined by stairway component.

Guards

The guards are located at the edge of the stair when the edge of the stair is more than 30 inches above adjacent grade (International Building Code). The top of guard is required to be 42 inches high above the walking surface of the stair. Gaps between the guard and the walking surface may not be wide enough to allow a 4-inch sphere to pass.

See Section 3. Typical Designs. Guards and handrails need to be designed to resist a linear load of 50 pounds per linear foot and a concentrated load of 200 pounds.

Handrails

The handrails must be located on both sides of the stairs. The handrail must be between 34 and 38 inches high. The handrail gripping surface needs to be continuous, without interruption for the full length of each stair flight. The 12-inch horizontal extension is located at the top of the stairs. The tread depth extension is located at the bottom of the stair.

Gripping surface requirements change depending on shape. For a circular cross section, the handrail needs to be 1¼ and 2 inches in diameter. For a non-circular cross section, the perimeter dimension of the handrail needs to be 4 inches minimum and 6¼ inches maximum, and a cross section dimension of 2¼ inches maximum.

Landings

The landings need to be located at least every 12 feet of elevation. Landings are required to be not fewer than 48 inches deep in the direction of travel. The landing must be designed to prevent accumulation of water.

Treads

Stair treads shall be a minimum of 11 inches deep. Stair treads shall not accumulate water, and not be steeper than 1:48 slope. Stair treads shall have a maximum radius of ½ inch at the nose of the tread, and shall not extend more than 1½ inches over the riser below. Although not required but advised as a consideration by ADA Section 504.4, there should be a visual contrast between tread nosings and the risers below to accommodate people with low vision.

Risers

The stair risers shall be between 4 and 7 inches. Open stair risers are not allowed for handicap accessible stairs.

Stairway Width

The primary determination of stairway width is the geography of the site. The International Building Code (IBC) dictates stairways with occupant loads of less than 50 shall not have a width of less than 36 inches. To accommodate the comfortable passing of two people on a stairway, the cost estimates included in this report assume a width of six feet.

1.4. Standards Requirements

The three major sources for stairway design standard requirements are:

- 2015 International Building Code (IBC), particularly Chapter 11 "Accessibility"
- 2009 ICC / ANSI A-117.1—American National Standards Institute's (ANSI) "Accessible and Usable Facilities and Buildings"
- 2010 Americans with Disabilities Act (ADA) Standards for Accessible Design (DOJ 9/15/2010)

1.5. Cost Estimates

Labor, material, and equipment pricing included below are based on RSMeans 2017 published cost data for the Pittsburgh, PA area. RSMeans is the leading provider of construction cost data. Cost book pricing is supplemented with local wage determinations, vendor pricing for specialty items, and Equipment Watch blue book rates for major equipment. Wood stands out as the cheapest initial material cost and steel as the highest. The cost estimates per structure/material combination (includes a six-foot wide stairway with two flights of seven risers with a three-foot landing) are:

- **Cast-in-place concrete:** $23,556
- **Precast concrete:** $23,753
- **Steel:** $40,940
- **Wood:** $10,416
- **Fiberglass treads on steel structure:** $37,064

Life cycle cost estimates (LCCE) were determined by taking the initial cost estimates per each structure/material combination and adding maintenance costs over a 75-year period. The results show that, over that period, steel is the most cost-effective structure and tread option, despite the fact that the initial cost of steel is nearly double that of concrete. This cost effectiveness is a result of steel's lifespan: well-maintained steel requires only maintenance not replacement (like other materials) during the 75-year period. However, concrete's life cycle cost over a 75-year period averages out to about $900 a year. The LCCE's for each material are:

- **Cast-in-place concrete:** $69,109
- **Precast concrete:** $69,074
- **Steel:** $61,090
- **Wood:** $94,874
- **Fiberglass treads on steel structure:** $64,485

A full cost summary can be found in the appendix.

2. Materials Investigation

The investigation reviews the characteristics of each type of material—steel, concrete, fiberglass, and wood—in terms of cost, buildability, life span, maintenance needs, and its compatibility with other materials to provide clear guidance on the benefits and weaknesses of each.

Following this review, the results are summarized into a matrix comparing the four materials against the three components of a stairway - railing, treads, and structure. The matrix summarizes the information included in this investigation as a means of directing users to the appropriate material depending on its strengths and weaknesses.

2.1. Steel

2.1.1. Steel Railings and Guards

Cost

The estimated material cost for two 1½ diameter pipe galvanized steel railings running two flights of stairs with seven treads each and one three-foot landing is $3,600.

No other material is recommended for railing.

Buildability

Steel railings can be fabricated in sections off site and then shipped to the site for final installation and finish. Steel railings can be installed with the following connections: a bolted plate connection for attachment to wood, steel, or concrete; welded in place connections for attachment to existing steel; or embedded stainless steel sleeved connection for installation in new concrete.

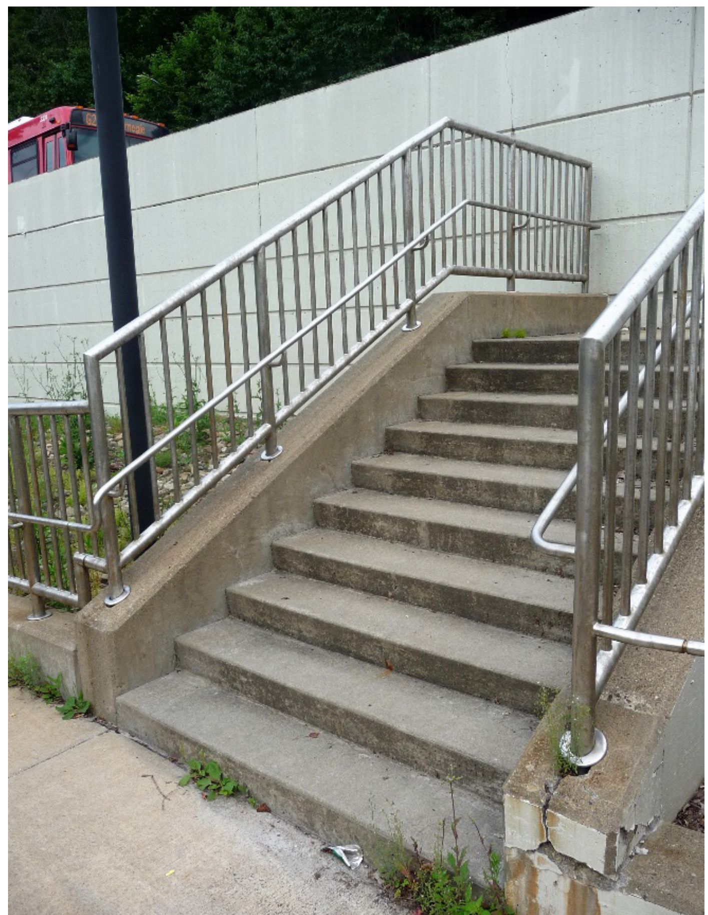
Lifecycle

Lifecycles by material are estimated to be: 20 years with galvanized pipe railing; 30 years with galvanized and painted pipe railing; 50 years with stainless steel railing.[3] Actual performance depends on location and use and maintenance.

Maintenance

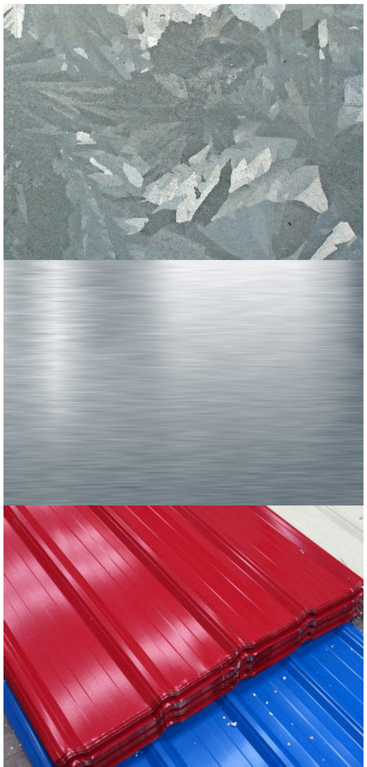
Maintenance varies depending on type of steel and coating. Steel railings are available in painted steel, galvanized steel, galvanized steel with a painted coating, and stainless steel. Painted steel railings have the lowest initial cost and are the least durable, requiring regular maintenance for the paint coating. Galvanized steel offers better durability than painted steel railings. Galvanized steel with painted coating is even more durable than just a galvanized steel railing. Water-based industrial enamel and polyurethane are coatings to consider for galvanized steel.

With bolted connections, the bolts should be hot dipped galvanized or stainless steel for corrosion resistance. Of those railing systems listed above, stainless steel railings are the most durable.



Stainless steel railing on concrete steps in Pittsburgh

3 Princeton Building Component Useful-Life Standards: https://facilities.princeton.edu/sites/facilities/files/1.2-4.pdf



Galvanized (top), stainless (middle), and coated (bottom) steel finishes

The most likely areas of early maintenance work would be on horizontal surfaces, such as base plates and connection components. Painted surfaces - galvanized or not - will need to be regularly monitored and recoated as needed.

Galvanizing may be cleaned using a water-based emulsifier, alkaline-based cleaners with a pH of 12 or lower, or organic solvents. If there is physical damage to the galvanized coating of the product (e.g. coating is chipped or fabrication after galvanizing has taken place), it is recommended that the damaged area be repaired in accordance with Australian/New Zealand Standard (AS/NZS) 4680. Paints, such as graffiti, can be removed using thinners. If some form of scraping is required, use of plastic or wooden scrapers (not steel/metallic items) is recommended. If the paint is wet or fresh, then normal thinners can be used. Once the paint has hardened, then a non-alkaline stripper can be used.

Poorly maintained, uncoated surfaces, or those surfaces with damaged coatings may be expected to show some oxidation or rust within a 5- to 10-year time frame.

Compatibility with Other Materials

Unpainted steel should be separated from any adjacent different metals. Unfinished steel should be protected from corrosion with surface coatings including galvanized surfaces, painted surfaces, or both galvanized and painted surfaces. Uncoated steel is not compatible with sodium chloride salts or acids.

Three methods for attaching steel railing to concrete: recessed receiving tube, side-mounted bracket, and plate mount.

Depending on the method of attachment, steel railings may cause damage to concrete. The most frequent occurrence of this damage happens when rain and salt penetrate the socket holding a steel rail. Three common connection assemblies that substantially reduce damage to the concrete include: the use of a recessed stainless steel tube to receive the steel handrail; the use of galvanized or stainless steel side brackets that are mounted to the side of the stair with the handrail bolted to the brackets, and; the use of a plate mounted to the base of the vertical handrail and then bolted into the concrete.

Other Considerations

Finishes offered by some manufacturers include hot dipped galvanization for shop or field painting, red oxide primer for shop or field painting, and powder coating.

Some manufacturers offer powder coated perforated infill panels in steel, aluminum, stainless steel, or perforated plastic.

2.1.2. Steel Treads

Cost

The estimated material cost for 14 steel grating treads and risers is $9,996. One steel grating landing at 3 feet by 6 feet is estimated at $1,080. This is the most expensive tread and riser combination investigated.

Buildability

The connection of steel treads can be accomplished with bolted connections to the structure below (wood, steel, or concrete) or the treads can be welded to an underlying steel structure.

Lifecycle

Similar to steel railings and guards, proper periodic review of the railing and correct maintenance of the coating (e.g. galvanized, paint, etc.) give the stair railing and guard a lifespan of 15 to 20 years.

Maintenance

Hot dipped galvanized and stainless steel treads offer the best maintenance value. Galvanized treads offer good durability, but would require periodic replacement after the galvanized finish wears off and the underlying steel starts to rust. Repair of damaged galvanized surfaces can be accomplished by application of a zinc rich paint, per ASTM A780.

Stainless steel with a non-slip coating is very low maintenance. Periodic repair and maintenance of minor scratches and oxidation can be accomplished with the use of a non-abrasive compound or cleaner, and rinsing with water. Steel wool, steel brushes, and cleaners containing bleach should be avoided. Exterior treads should not be painted on the tread surface, due to high maintenance and safety considerations.

The most likely areas of early maintenance work would be horizontal surfaces (base plates), and connection components, such as bolted connections. Bolted connections should be hot dipped galvanized coated steel or stainless steel.

Depending on the timing and proper maintenance procedures, maintenance can be addressed over a 10- to 15-year time frame, with annual review for replacement based on specific conditions thereafter. Annual reviews for steel treads would check for rust, broken treads, vandalism, and overgrown vegetation. This once-a-year review will account for the specific local conditions per step and prompt maintenance as needed rather than basing maintenance on expected life.

Compatibility with Other Materials

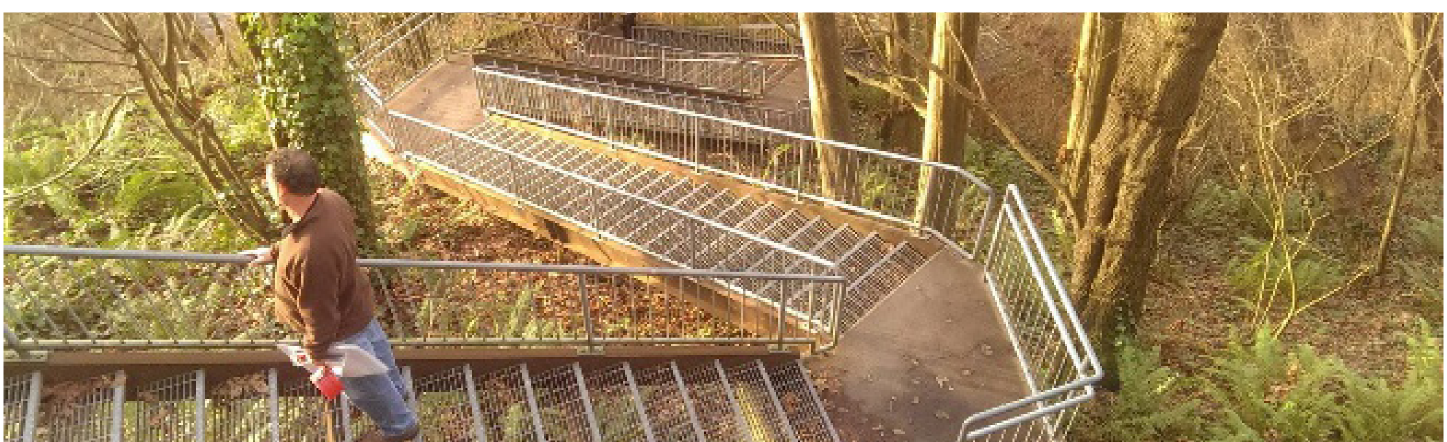
Unpainted steel should be separated from adjacent different metals. Unpainted or non-galvanized steel is not compatible with salts or acids.

Other Considerations

Finishes offered by some manufacturers include hot dipped galvanized, stainless steel, and prefinished anodized aluminum treads- also available for exterior uses with some integral closed risers. Various colors for steel tread nosings are available from some manufacturers.

For stair treads located on above grade structures, perforated metal, open grid or grating type steel treads with non-skid surfaces are generally safer to walk on in winter weather than solid surfaces since the snow and ice will not collect as much on the walking surface.

Some manufacturers offer renovation kits to place prefinished steel tread over an existing work tread. Some offer treads for high visibility or night time use.



Open-grate steel treads on steel structure

2.1.3. Steel Structure

Cost

Cost is a fundamental consideration in the selection of structural material, which is a key early decision in the design process. A number of factors can be considered to have a key impact on the price of steel structures.

The estimated material cost for column footings, steel framing and columns, and steel stringers that run two six-foot wide flights of seven risers with a three-foot landing is $8,000. This is the most expensive structure investigated.

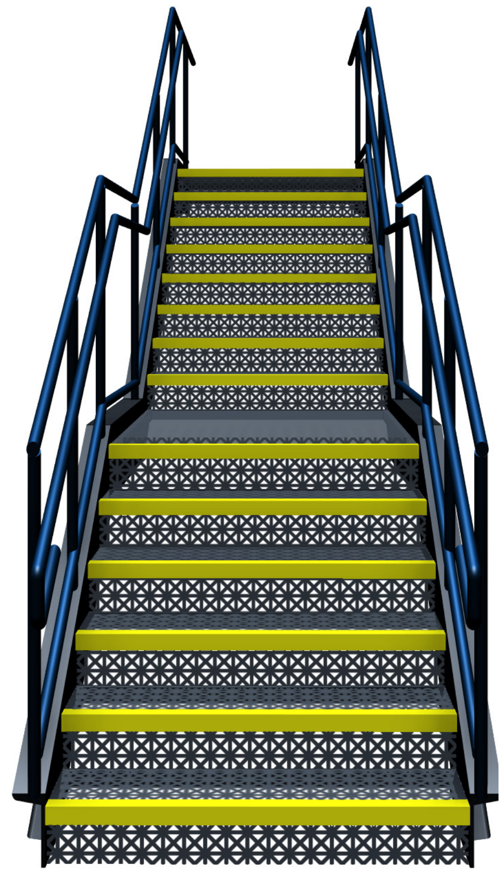
A steel structure is comparatively lighter than concrete structure. This reduced weight has a beneficial effect on reducing structure foundation dimensions.

The complexity of the structure is closely related to specific site conditions. Complex structural solutions, such as transfer structures, and fabricated beams may also need to be introduced to overcome project specific features or restrictions such as adjacency of other buildings, ground conditions, and so on. Complex connection details may also impact installation costs, tolerances, and interfaces.

The location of a project is a key factor in price determination. Not only is the geographic location of the site an important consideration, site specific features also need to be reviewed. While the design of two stairway structures may be very similar, the logistics and access arrangements will vary significantly between a city center congested site and an easily accessible, isolated business park or industrial estate site, or even between alternative city center sites. Working in city centers or occupied areas can mean restrictions to working hours, noise, deliveries, and crane operation, all of which influence installation costs and can result in an extended on-site construction time. As the structure construction is generally a critical path activity, any increase to the construction cost will have an associated impact on overall project cost.

Buildability

The erection of structural steelwork consists of the assembly of steel components into a frame on site. The processes involve lifting and placing components into position, then connecting them together. Generally, this is achieved through bolting but sometimes site welding is used. Choosing simply assembled connections will affect the ability to use site welding. For a joint to be site-welded in position, the members will need to be held securely in position such that the fit-up for welding is accurate and rigid. This will typically require both a temporary bolted connection and additional temporary supports. The need to provide these additional facilities often results in site welding being an expensive option.



Rendering of open-grate steel treads on steel structure

Steel erection requires use of truck-mounted cranes or crawler cranes. Normally, truck-mounted cranes do not require a back-up crane for site assembly, and require very little set-up time. These two attributes mean that they are suitable for one-off, single day commissions. Their main drawback is that to achieve a high lifting capacity from a light vehicle, a larger footprint is required than would be for an equivalent crawler crane. The size of the footprint can be increased using outriggers, but good ground conditions are necessary to provide a solid base and ensure adequate stability. Crawler cranes are more rugged than truck-mounted cranes. Ground conditions are therefore less critical. Crawler cranes may travel with suspended loads on site, because they are stable without the use of outriggers. They also have a relatively high lifting capacity. Daily hire is not possible for crawler cranes, because transportation to and from site is expensive, and they require site assembly. They are however more competitive than truck-mounted cranes for long periods on site in a relatively fixed location. All-terrain cranes provide a compromise between the advantages and disadvantages of crawler cranes and truck-mounted cranes. They are about 20% more expensive to hire than the latter.

Lifecycle

Unlike concrete, erected steelwork does not shrink or creep. Steel is also highly durable. Steel is strong and ductile too, making it highly resistant to accidental damage. If any damage does occur, it can easily be repaired by cutting, welding or bolting to restore its full strength. Steelwork erection on site is not restricted by weather conditions (other than high winds) and can continue year-round, with no need for special protection measures in winter.

The total cost for a steel staircase on steel structure with two six-foot wide risers of seven treads each with a three-foot landing at six feet wide after 75 years of regular maintenance (requiring no replacement) is $61,090.

Maintenance

Cost effective corrosion protection of structural steelwork should present little difficulty for common applications and environments if the factors that affect durability are recognized at the outset. There are many steel structures that have continued in use satisfactorily for many years even in adverse conditions. Today, modern durable protective coatings are available which, when used appropriately, allow extended maintenance intervals and improved performance. The key to success lies in recognizing the corrosiveness of the environment to which the structure will be exposed and in defining clear and appropriate coating specifications. Where steel is in a dry heated interior environment the risk of corrosion is insignificant and no protective coating is necessary. Conversely, a steel structure exposed to an aggressive environment needs to be protected with a high-performance treatment and may need to be designed with maintenance in mind if extended life is required.

The optimum protection treatment, which combines appropriate surface preparation, suitable coating materials, required durability and minimum cost, is achievable using modern surface treatment technology.

Compatibility with Other Materials

Many projects require structural or non-structural connections between steelwork and other materials such as concrete, masonry, wood or fiberglass. Connection detail should recognize the physical characteristics of both steelwork and the material to which the steelwork is connected. Details should generally seek to optimize structural requirements, buildability and cost.

Other Considerations

Steel frame installation and its ability to be pre-manufactured offers construction advantages due to certainty of delivery and speed of installation. This results in a reduction in on-site labor, which reduces health and safety risks.

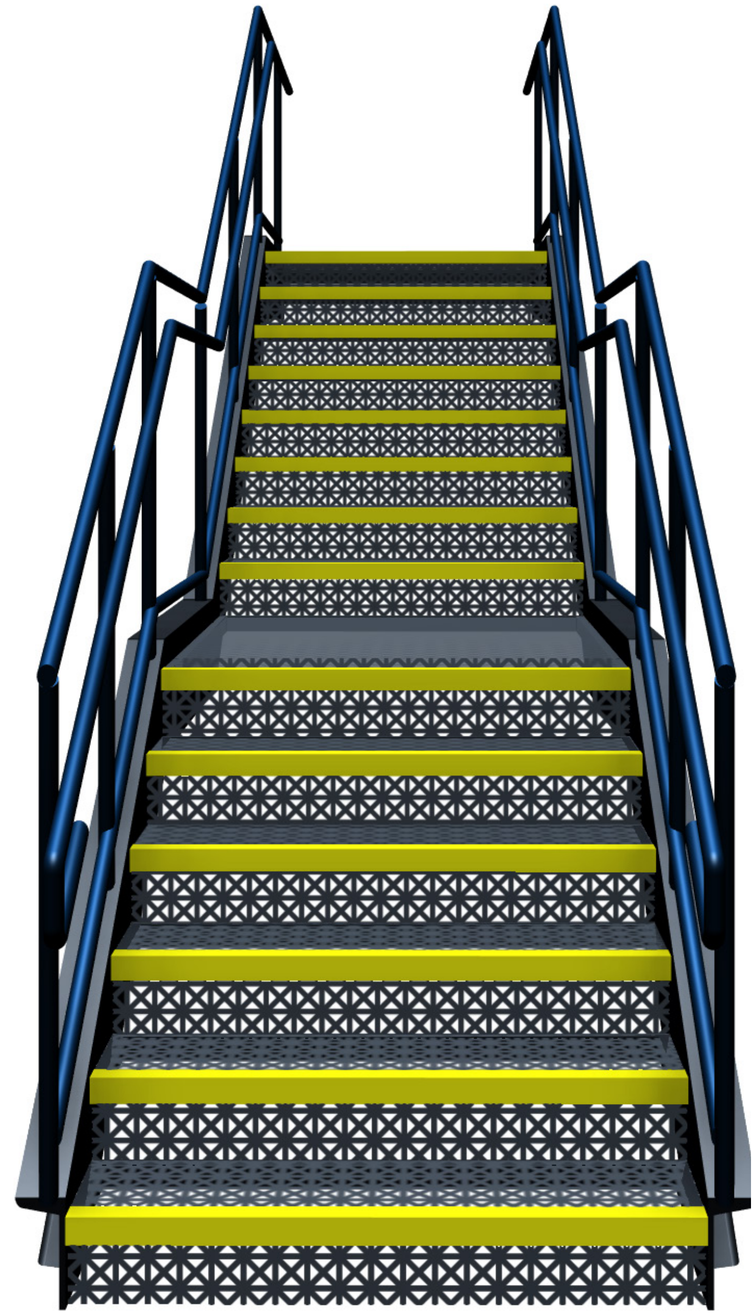
STEEL STEPS
COST AND ADVANTAGES

COSTS AND MAINTENANCE
Construction Costs: $40,940*
Construction Difficulty: Difficult
Life Cycle Costs (75 Years): $61,100
Maintenance: Not easily damaged with preventive maintenance
Compatibility with other materials: Moderate

ADVANTAGES
Strongest material
Longest lifespan and lowest life cycle costs
Repairs can be completed with welding or bolting

DISADVANTAGES
Most expensive construction cost
Not easily constructed in densely built conditions
Requires cranes to construct

*FOR A SPAN OF TWO RISERS OF SEVEN TREADS EACH AND ONE 3'X6' LANDING, INCLUDING CONCRETE STRUCTURE. STRUCTURE COSTS VARY WIDELY IN ACTUAL STEPS CONSTRUCTION PROJECTS

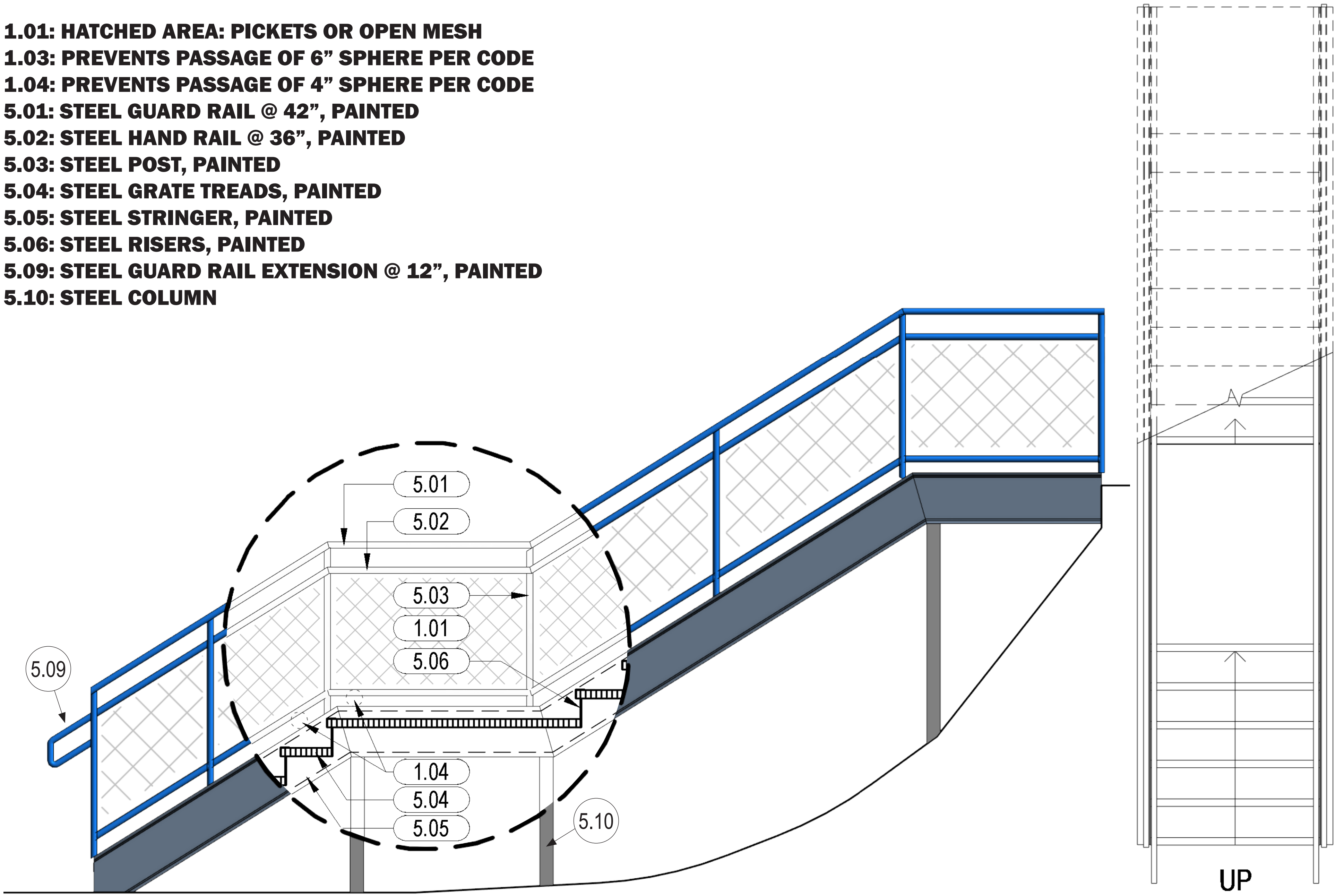


NATIONWIDE BEST PRACTICES

Steel steps are best used in extreme terrain conditions. Both Seattle and Portland use steel where landslides are common.

STEEL STEPS
DIAGRAMS

1.01: HATCHED AREA: PICKETS OR OPEN MESH
1.03: PREVENTS PASSAGE OF 6" SPHERE PER CODE
1.04: PREVENTS PASSAGE OF 4" SPHERE PER CODE
5.01: STEEL GUARD RAIL @ 42", PAINTED
5.02: STEEL HAND RAIL @ 36", PAINTED
5.03: STEEL POST, PAINTED
5.04: STEEL GRATE TREADS, PAINTED
5.05: STEEL STRINGER, PAINTED
5.06: STEEL RISERS, PAINTED
5.09: STEEL GUARD RAIL EXTENSION @ 12", PAINTED
5.10: STEEL COLUMN



2.2. Concrete

2.2.1. Concrete Railings and Guards

Concrete is not recommended for railing and guards.
See Section 2.1. Steel Railings and Guards.

2.2.2. Concrete Treads

Cost

The estimated material cost for 14 precast tread and integral risers is $4,410. One precast landing at 3 feet by 6 feet is estimated at $630.

The estimated material cost for 14 cast-in-place treads and risers is $4,620. One cast-in-place landing at 3 feet by 6 feet is estimated at $432.

These costs are lower than steel but higher than wood and fiberglass.

Buildability

Offsite form work is needed for the manufacture of single concrete treads. Replacement concrete treads can be produced by local manufacturers with some limitations, and have been produced for some time by the Pittsburgh Department of Public Works (DPW). If storage is available, DPW could cast treads in slower months for usage as-needed.

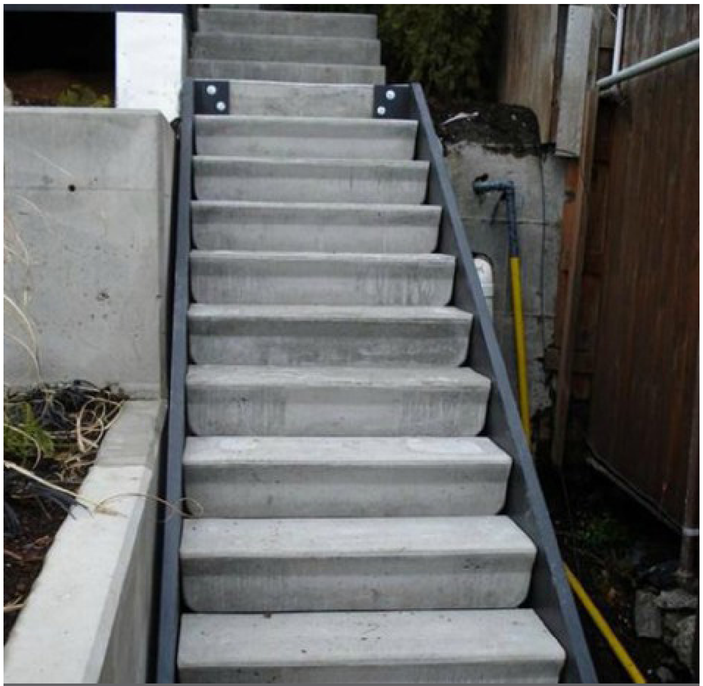
Because a single concrete stair tread can weigh 100 to 150 pounds, the labor needed for the replacement and installation of a single tread for a stair located on a typical steep Pittsburgh hill has been very challenging, according to Pittsburgh DPW staff.

Lifecycle

Depending on the location and use, the duration of some concrete steps has been found to last from 45 to 75 years.[4]

Maintenance

Uncoated concrete treads can be periodically treated with a sealer, and will need to be retreated occasionally. Uncoated concrete treads can be covered with a “sacrificial” fiberglass covering that can be replaced.



Individually replaceable, precast closed-tread concrete steps on concrete structure.

Depending on the timing and proper maintenance procedures, maintenance can be addressed over a 10- to 15-year time frame, with annual review for replacement based on specific conditions thereafter. Annual reviews for concrete treads would check for spalling, cracking, breaking, vandalism, and overgrown vegetation. This once-a-year review will account for the specific local conditions per step and prompt maintenance as needed rather than basing maintenance on expected life.

Compatibility with Other Materials

Aluminum is not compatible with concrete and will corrode on contact. Sodium chloride can promote the corrosion of embedded steel rebar.

Other Considerations

Although replacement concrete treads are presently produced by Pittsburgh DPW, and technically can be produced by local manufacturers, individual replacement treads may not be included on a manufacturer’s standard product list. In this case, a “typical tread” design may be worth exploring for manufacture by local companies, to augment the supply of treads presently produced by the Pittsburgh DPW.

4 Princeton Building Component Useful-Life Standards: https://facilities.princeton.edu/sites/facilities/files/1.2-4.pdf

2.2.3. Concrete Structure

Cost

The estimated material cost for six 12-inch cast in place piers (8 feet total length, 4 feet below grade) needed to support two six-foot wide flights with seven risers each and a three-foot landing is $3,450.

The self-weight of concrete is more than compared to other materials. The foundation for the concrete structure should be strong because of the larger weight of concrete. This increases construction cost.

It takes more time to construct the concrete structures, which affects cost. The concrete structures generally need 28 days before they are ready to use. However, their manufacturing and installation require less skilled labor, lowering the cost of construction.

Buildability

Most concrete is batched and mixed in a central location called a ready-mix plant and then trucked to the desired location. This is often the best solution even for small jobs. Ready-mix plants have a wide variety of aggregate and cement that are stored under controlled conditions, as well as good equipment for weighing and mixing. As a result, the quality of the concrete should be high and consistent. Concrete mixing trucks can be used to transport already mixed concrete, or the mixing can be performed by the truck as it is traveling to the site. One potential disadvantage of ready-mixed concrete is that the time required to transport the concrete to the site may use up too much of the early period of good workability. This can generally be handled with retarding admixtures.

Once the concrete has been adequately mixed, it must be placed into the formwork that defines its final position and shape. If the concrete is to be reinforced, the rebar must already be in place so the concrete can flow around it. If the concrete mixing truck can be located close to (and higher than) the site, then the concrete can be poured directly into the forms. In cases where this is not possible, the concrete can be transferred in buckets by a crane or by wheelbarrow. When this is impractical due to the distance required or the size of the job, the fresh concrete can be pumped through a system of pipes or hoses to the site by special concrete pumps. Concrete that is to be pumped has more stringent requirements for workability. If the concrete is too dry, it will not pump well, while if it is too wet it will tend to segregate. Segregation can also occur if the concrete falls into the formwork too quickly, as larger aggregate particles will tend to be driven downward.

Rendering of poured-in-place concrete treads on concrete structure

Precast concrete steps on concrete structure

Properly curing concrete leads to increased strength and lower permeability and avoids cracking where the surface dries out prematurely. Care must also be taken to avoid freezing or overheating due to the exothermic setting of cement. Improper curing can cause scaling, reduced strength, poor abrasion resistance, and cracking.

The weather plays an important role in the curing process. Hot windy weather leads to rapid evaporation and thus particular care must be taken to keep the concrete moist. Cold weather causes the concrete to harden much more slowly than hot weather. This delays the construction process, but leads to better concrete in the long run, because the hydration products develop differently at different temperatures. If fresh concrete freezes, however, it will likely be destroyed beyond repair.

Lifecycle

Concrete is one of the most durable construction materials. It provides superior fire resistance compared with wooden construction and gains strength over time. Structures made of concrete can have a long service life.

While concrete structures are brittle and less earthquake resistant, they provide good resistance against externally applied forces such as high winds, hurricanes, and tornadoes owing to its lateral stiffness, which results in minimal horizontal movement. Structures constructed with cast-in-place reinforced concrete can resist winds of more than 200 miles per hour.

Concrete structures are more resistant to fire than those constructed using steel frames, since concrete has lower heat conductivity than steel and can thus last longer under the same fire conditions. It can endure very high temperatures from fire for a long time without loss of structural integrity.

The total cost for a cast-in-place concrete staircase with two six-foot wide risers of seven treads each with a three-foot landing at six feet wide after 75 years of regular maintenance (including one full replacement) is $69,109.

The total cost for a precast concrete staircase with two six-foot wide risers of seven treads each with a three-foot landing at six feet wide after 75 years of regular maintenance (including one full replacement) is $69,074.

Concrete steps in need of repair

Maintenance

Concrete can be damaged by many processes, such as the expansion of corrosion products of the steel reinforcement bars, freezing of trapped water, salt, fire or radiant heat, aggregate expansion, bacterial corrosion, leaching, erosion by fast-flowing water, physical damage, and chemical damage (from carbonation, chlorides, sulfates and distillate water).

Compatibility with Other Materials

Concrete is compatible through bolted connections with multiple construction materials such as steel, fiberglass, and wood. See Section 2.1.1 Steel Railings and Guards for more information about connections between the recommended steel railings and concrete steps.

CONCRETE STEPS
COST AND ADVANTAGES

COSTS AND MAINTENANCE
Construction Costs: $23,600*
Construction Difficulty: Difficult
Life Cycle Costs (75 Years): $69,000**
Maintenance: Easily damaged but easily repaired
Compatibility with other materials: High

ADVANTAGES
Low life cycle costs
Low maintenance costs, easy repairs
Can be manufactured and constructed by DPW

DISADVANTAGES
Brittle material, easily damaged
Heavy material slows down repairs (tread replacement)
Can only be poured on site in specific conditions

*FOR A SPAN OF TWO RISERS OF SEVEN TREADS EACH AND ONE 3'X6' LANDING, INCLUDING CONCRETE STRUCTURE. STRUCTURE COSTS VARY WIDELY IN ACTUAL STEPS CONSTRUCTION PROJECTS

**INCLUDES ONE FULL REPLACEMENT AT 50 YEARS

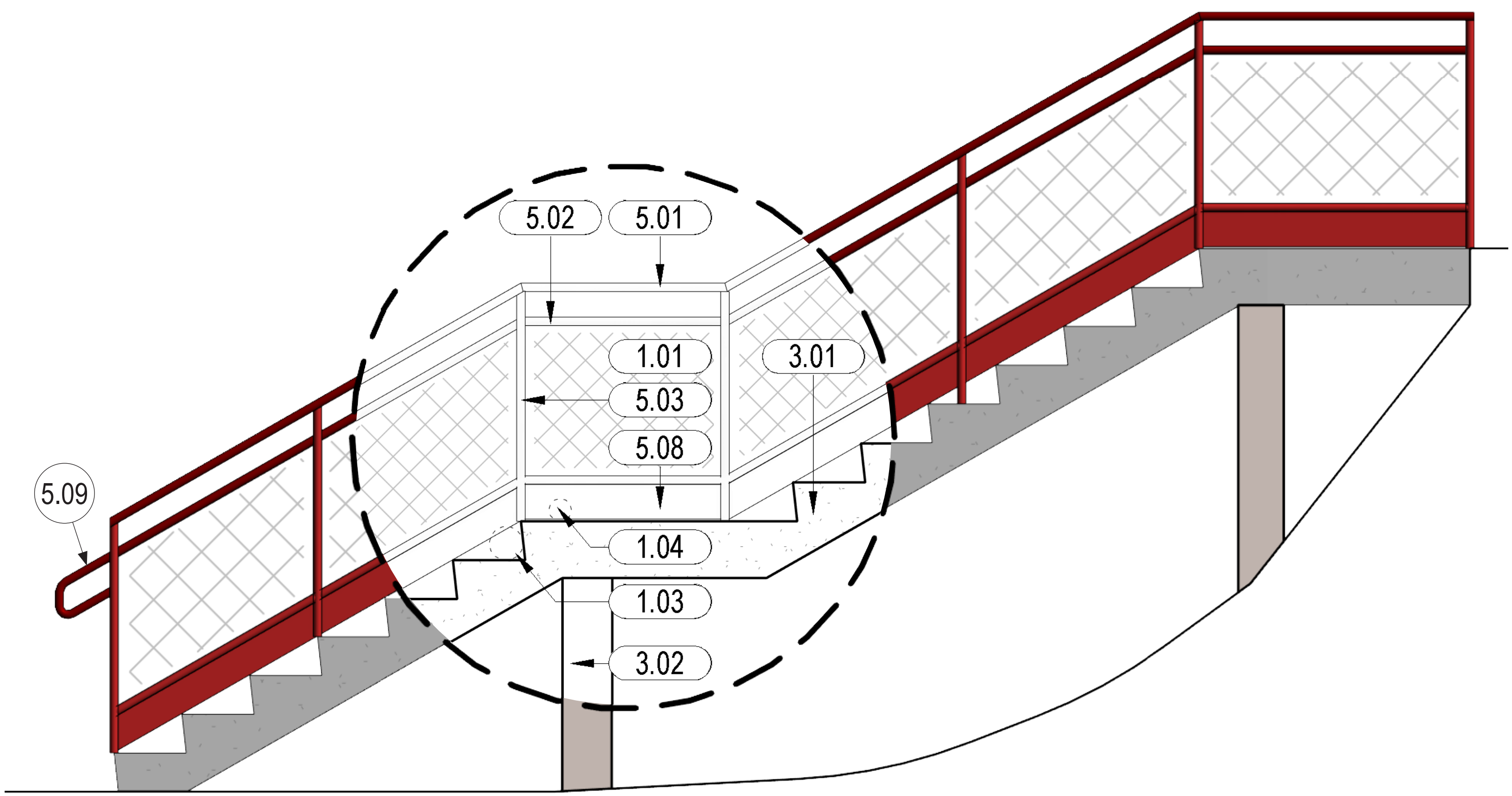
NATIONWIDE BEST PRACTICES

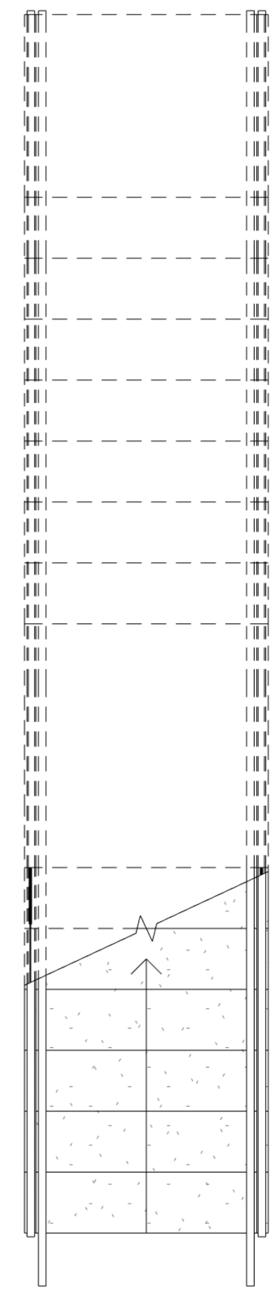
Concrete steps are the standard in Cincinnati, Seattle, and Portland. Apart from atypical site conditions, these three cities do not consider other materials for construction.

With program budgets ranging from fully funded to underfunded, concrete has proven to be the most cost effective material when it comes to life cycle and maintenance.

CONCRETE STEPS
DIAGRAMS

1.01: HATCHED AREA: PICKETS OR OPEN MESH
1.03: PREVENTS PASSAGE OF 6” SPHERE PER CODE
1.04: PREVENTS PASSAGE OF 4” SPHERE PER CODE
3.01: CONCRETE RISERS AND TREADS
3.02 CONCRETE SUPPORT PILES
5.01: STEEL GUARD RAIL @ 42”, PAINTED
5.02: STEEL HAND RAIL @ 36”, PAINTED
5.03: STEEL POST, PAINTED
5.08: PAINTED STEEL PLATE AT RAILING
5.09: STEEL GUARD RAIL EXTENSION @ 12”, PAINTED





2.3. Fiberglass Reinforced Plastic

2.3.1. Fiberglass Railings and Guards

Fiberglass is not recommended for railing and guards. See Section 2.1. Steel Railings and Guards.

Most of the railing systems the team researched were found to be either for light residential use or industrial use. There are a limited number of suppliers that can provide a handicap accessible railing compared to suppliers of other railing systems. Rails and guards may need to be internally reinforced and have special connections to sustain the code-mandated resistance for concentrated loads (200 lbs) and linear loads (50 lbs/ft).

2.3.2. Fiberglass Treads

Cost

The estimated material cost for 14 fiberglass treads is $3,080. One fiberglass landing at 3 feet by six feet is estimated at $288. This cost is lower than steel and concrete.

A sample of open-grate fiberglass treads on steel structure

Buildability

Fiberglass treads are very lightweight compared to conventional materials for treads such as steel and concrete. Stair treads come in different configurations including: molded fiberglass tread covers over existing or new wood, steel or concrete treads (see Section 2.5.3 Repair—Fiberglass Overlay on Concrete Tread); and fiberglass grating used for treads as part of a complete fiberglass system or for connection to a steel structure.

Based on initial research, a very limited number of local companies manufacture or distribute fiberglass treads. Further research is needed to confirm that non-proprietary fiberglass systems are available from these companies.

Lifecycle

Although no long-term data for fiberglass treads are available, with annual inspection and proper maintenance, the tread should last longer than wood treads, and an almost comparable time line as galvanized steel treads.

If placed on a steel structure, the total cost including two six-foot wide risers of seven fiberglass treads each with a three-foot fiberglass landing at six feet wide after 75 years of regular maintenance (including two fiberglass component replacements) is $64,485.

Maintenance

Clips and connections to other materials should be inspected annually for wear, loose connections, and cracking. Fiberglass grating used for treads should be inspected annually and replaced as needed. Molded fiberglass stair tread covers should generally require little maintenance, and once damaged should be replaced. Depending on the chemistry of the resin that the manufacturer uses in the fiberglass, a polymer coating, or paint may be needed to provide ultraviolet (UV) resistance.

Compatibility with Other Materials

Fiberglass is generally compatible with most building materials, but is not resistant to some chemicals.

Other Considerations

Some manufacturers offer fiberglass stair grates as treads along with fiberglass covers over existing treads.

2.3.3. Fiberglass Structure

Though strong for its weight, fiberglass reinforced plastic (FRP) is not as strong as a steel or concrete. In addition, FRP is considerably more flexible that steel or concrete, resulting is much larger deflections for identical members with the same loads. If FRP were to be used as a structure, it would require shorter spans and the consequent additional costs of more posts and footings. Alternately, larger FRP members might be used as compared to steel or concrete members of the same span length.

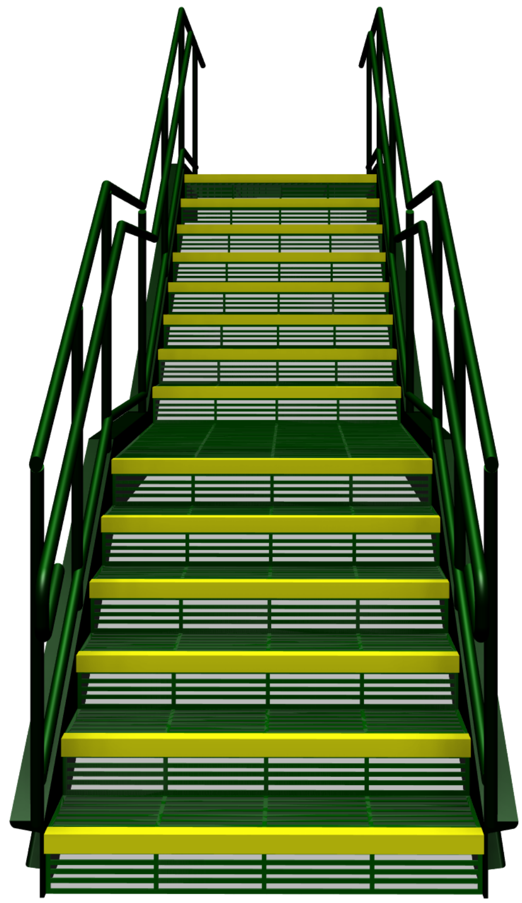
As with fiberglass treads, outdoor exposure results in UV light degradation of polymers used in FRP resins. Exposed surfaces will fade (yellow) and lose gloss. Eventually the fiberglass reinforcement closest to the surface will become exposed; this is called Fiberbloom. A UV stabilizer can be added which slows, but does not prevent, the effects of UV degradation. The best way to protect FRP structures from weathering is a protective coating such as urethane based paints.

The density, or unit weight, of FRP ranges from 107 to 121 pounds per cubic foot (pcf). Reinforced Concrete runs approximately 150 pounds per square foot and steel weighs 490 pcf. Fiberglass plastic is therefore significantly lighter than steel, and weighs about ¾ that of concrete.

If it is desirable to make FRP fire resistant, fire retardant resin systems can be used in the manufacture of the FRP structural shapes. However, these fire-retardant resins are more susceptible to UV degradation.

FRP structural members cannot be welded, but can be fastened together using bolted connections very similar to structural steel shapes. FRP angles are used with stainless steel bolts. Erection of FRP stair structures would be easier than steel or concrete, requiring a smaller crane.

The coefficient of thermal expansion for FRP is 33% less than steel and 20% less than reinforced concrete. As such, FRP will expand and contract less under temperature variations than those other materials.



Rendering of open-grate fiberglass treads on steel structure

FIBERGLASS STEPS
COST AND ADVANTAGES

COSTS AND MAINTENANCE
Construction Costs: $37,064*
Construction Difficulty: Difficult
Life Cycle Costs (75 Years): $64,485
Maintenance: Not easily damaged with preventive maintenance
Compatibility with other materials: High

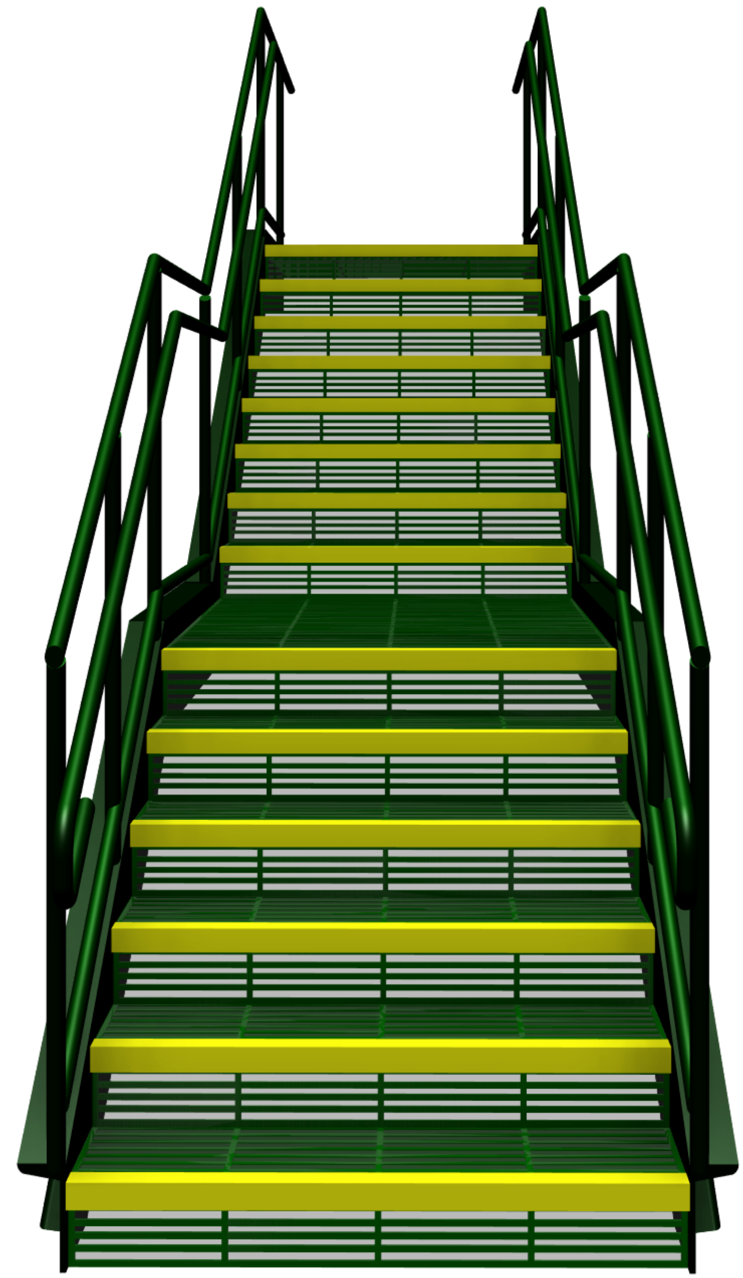
ADVANTAGES
Lightweight
Easily cut to size
Long lasting

DISADVANTAGES
Cannot be used as a structure
Higher life cycle costs than steel
Requires cranes to construct underlying steel structure

*FOR A SPAN OF TWO RISERS OF SEVEN TREADS EACH AND ONE 3'X6' LANDING, INCLUDING STEEL STRUCTURE. STRUCTURE COSTS VARY WIDELY IN ACTUAL STEPS CONSTRUCTION PROJECTS

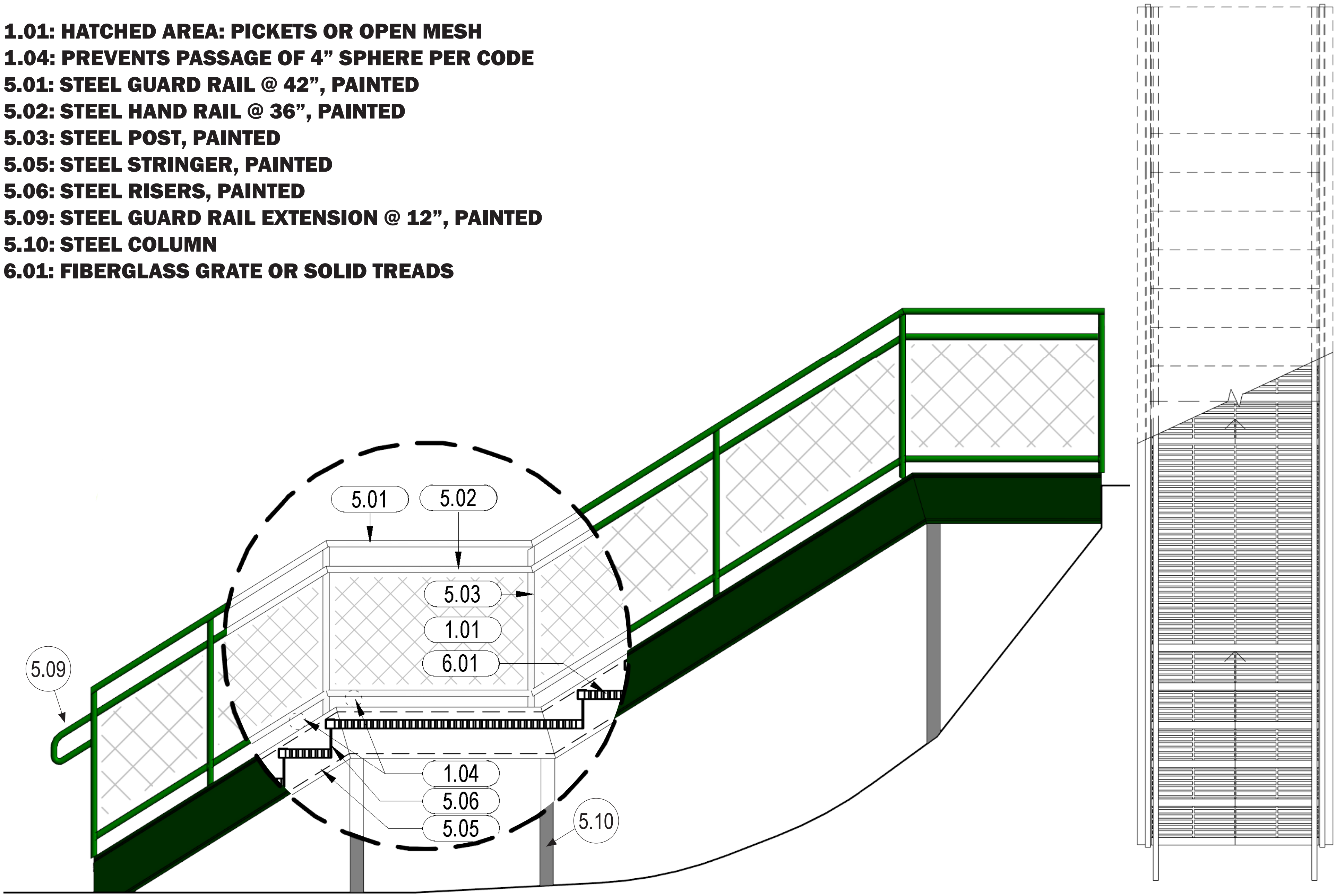
NATIONWIDE BEST PRACTICES

Cincinnati, Seattle, and Portland have not yet constructed steps using fiberglass.



FIBERGLASS STEPS
DIAGRAMS

1.01: HATCHED AREA: PICKETS OR OPEN MESH
1.04: PREVENTS PASSAGE OF 4" SPHERE PER CODE
5.01: STEEL GUARD RAIL @ 42", PAINTED
5.02: STEEL HAND RAIL @ 36", PAINTED
5.03: STEEL POST, PAINTED
5.05: STEEL STRINGER, PAINTED
5.06: STEEL RISERS, PAINTED
5.09: STEEL GUARD RAIL EXTENSION @ 12", PAINTED
5.10: STEEL COLUMN
6.01: FIBERGLASS GRATE OR SOLID TREADS



2.4. Wood

2.4.1 Wood Tread

Cost

The estimated cost for 14 wood treads is $1,610. Wood is the cheapest material of those investigated.

Buildability

Compared to steel and concrete, wood is a much lighter material to use in construction, although pressure treated members will be heavier than untreated wood. For tread repair, smaller crews of laborers can be used to replace wood treads on existing stairs.

Lifecycle

Depending on the location and usage, some pressure treated wood steps typically to last up to 15 years.[5] Construction of new wood stairs may not be as cost effective over the long term, given its relatively short lifecycle compared to steel, concrete, or fiberglass.

The total cost for wood staircase with two six-foot wide risers of seven treads each with a three-foot landing at six feet wide after 75 years of regular maintenance (including five full replacements) is $94,874, making this the least cost-efficient material investigated despite its low up-front cost.

Maintenance

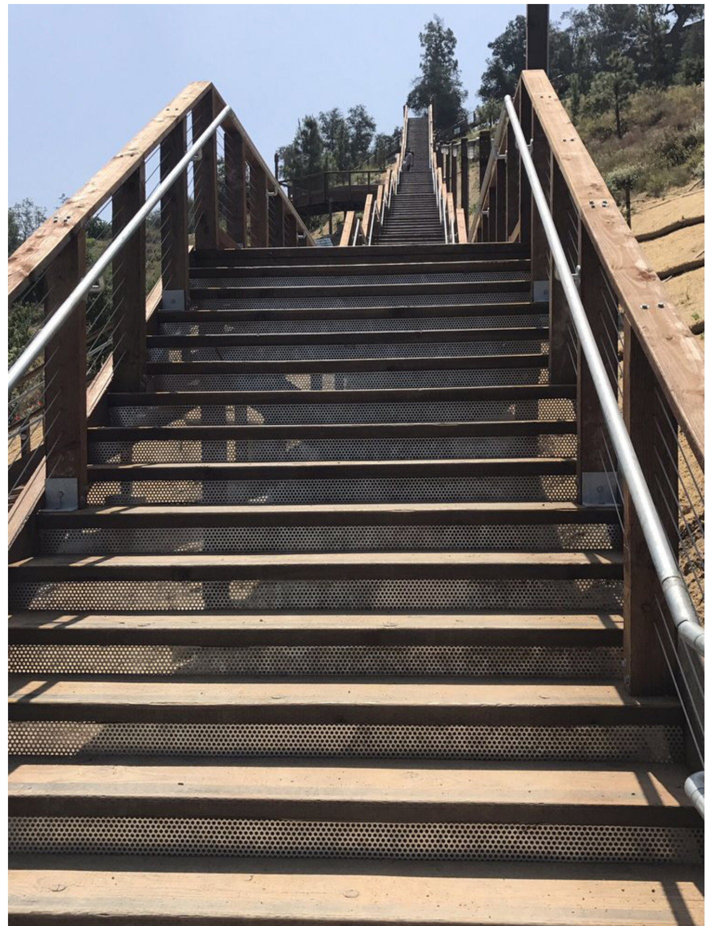
Pressure treated wood treads can be left untreated or covered with fiberglass.

Compatibility with Other Materials

Unfinished steel and aluminum should be separated from certain formulations of pressure treated wood due to galvanic corrosion, and higher grade galvanized or stainless steel connectors may be required.

Other Considerations

Some manufacturers offer water repellant chemicals included as part of the pressure treating process.



Wood treads on wood structure with steel railings

5 Princeton Building Component Useful-Life Standards: https://facilities.princeton.edu/sites/facilities/files/1.2-4.pdf

2.5. Rehabilitation

2.5.1 Replacement—Concrete Tread

The replacement of existing concrete treads with new concrete ones would typically involve the construction of new concrete treads off site, transporting them to the stair location, followed by demolition of the existing tread and installation of the new tread. The overall process includes on-site demolition of the existing tread and moving and lifting a new 100 to 150-pound concrete tread to the correct location of the existing stair for installation. The entire process is labor intensive, for the needed material.

2.5.2. Replacement—Wood Tread on Concrete Stringers and Supports

The replacement of existing concrete treads with wood treads would typically involve the on-site demolition of the existing concrete treads, and replacement with new wood pressure-treated treads. The demolition of the concrete would involve sledge hammer work; while the construction of the new treads could involve cutting the wood off site. The entire process would involve much less labor than the replacement of a concrete tread.

The estimated cost of one wood tread is $115.

2.5.3. Repair—Fiberglass Overlay on Concrete Tread

If the existing concrete tread is in stable condition with minor cracking, a fiberglass overlay could be attached to the existing tread. In most cases, the manufacturer's overlay is not structural, and relies on the existing concrete for support. This method could extend the operable life of the underlying concrete, and the fiberglass would be a sacrificial surface.

One fiberglass tread overlay is estimated at $175.

2.5.4. Repair—Concrete Structure

Overall concrete structure replacement should involve replacement of the existing steel railings and guards to comply with handicap accessibility laws and requirements, surface repair of existing minor surface abrasions and cracking, replacement of badly damaged existing treads with new treads, installation of overlay on existing treads as needed, installation of new infill risers to meet handicap requirements and building codes, and structural augmentation of the supporting concrete structure.

The cost estimate for a supplemental concrete column is $650.

REHAB CONCRETE STEPS
COST AND ADVANTAGES

COSTS AND MAINTENANCE*
Construction Costs: $25,796**
Construction Difficulty: Difficult
Life Cycle Costs (75 Years): N/A
Maintenance: Easily damaged but easily repaired
Compatibility with other materials: High

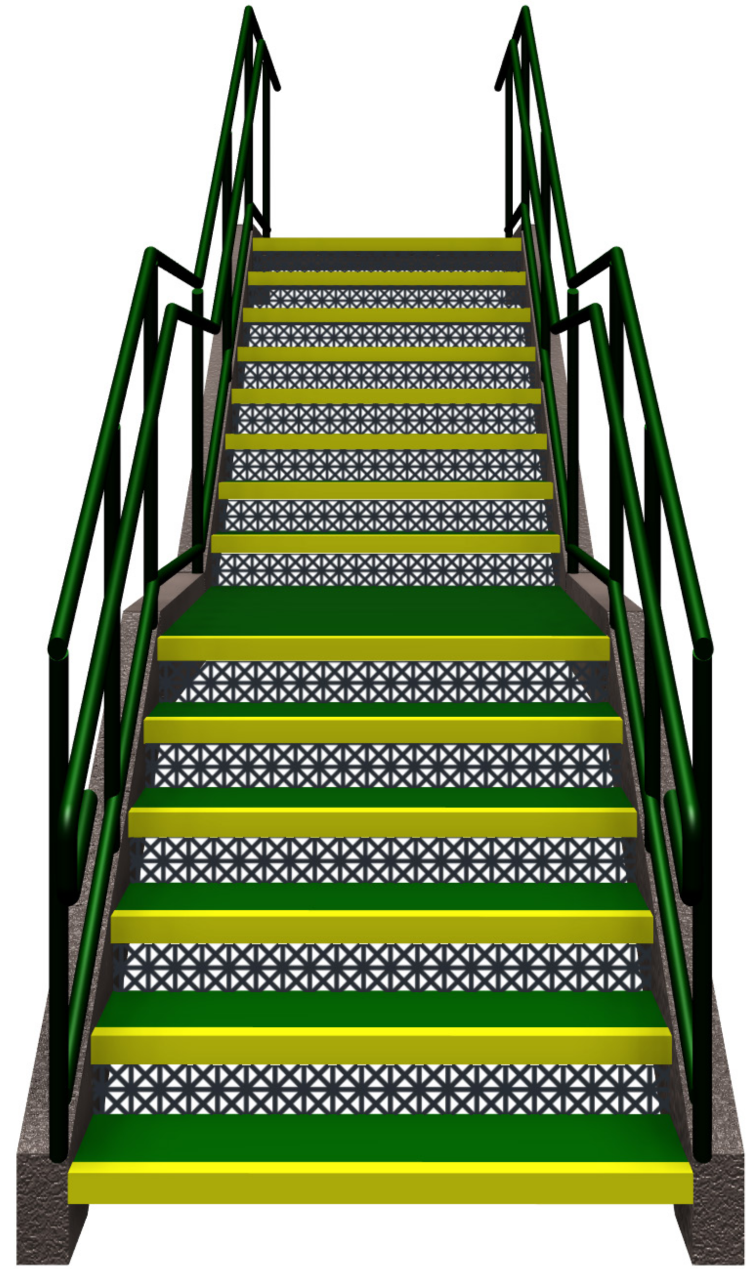
ADVANTAGES
Low maintenance costs, easy repairs
Can be manufactured and constructed by DPW

DISADVANTAGES
Brittle material, easily damaged
Heavy material slows down repairs

*FOR CAPPING CONCRETE TREADS WITH FIBERGLASS, ADDING STEEL RISER INSERTS, AND REINFORCING AND REPAIRING CONCRETE STRUCTURE OVER A SPAN OF TWO RISERS OF SEVEN TREADS. STRUCTURE COSTS VARY WIDELY IN ACTUAL STEPS CONSTRUCTION PROJECTS

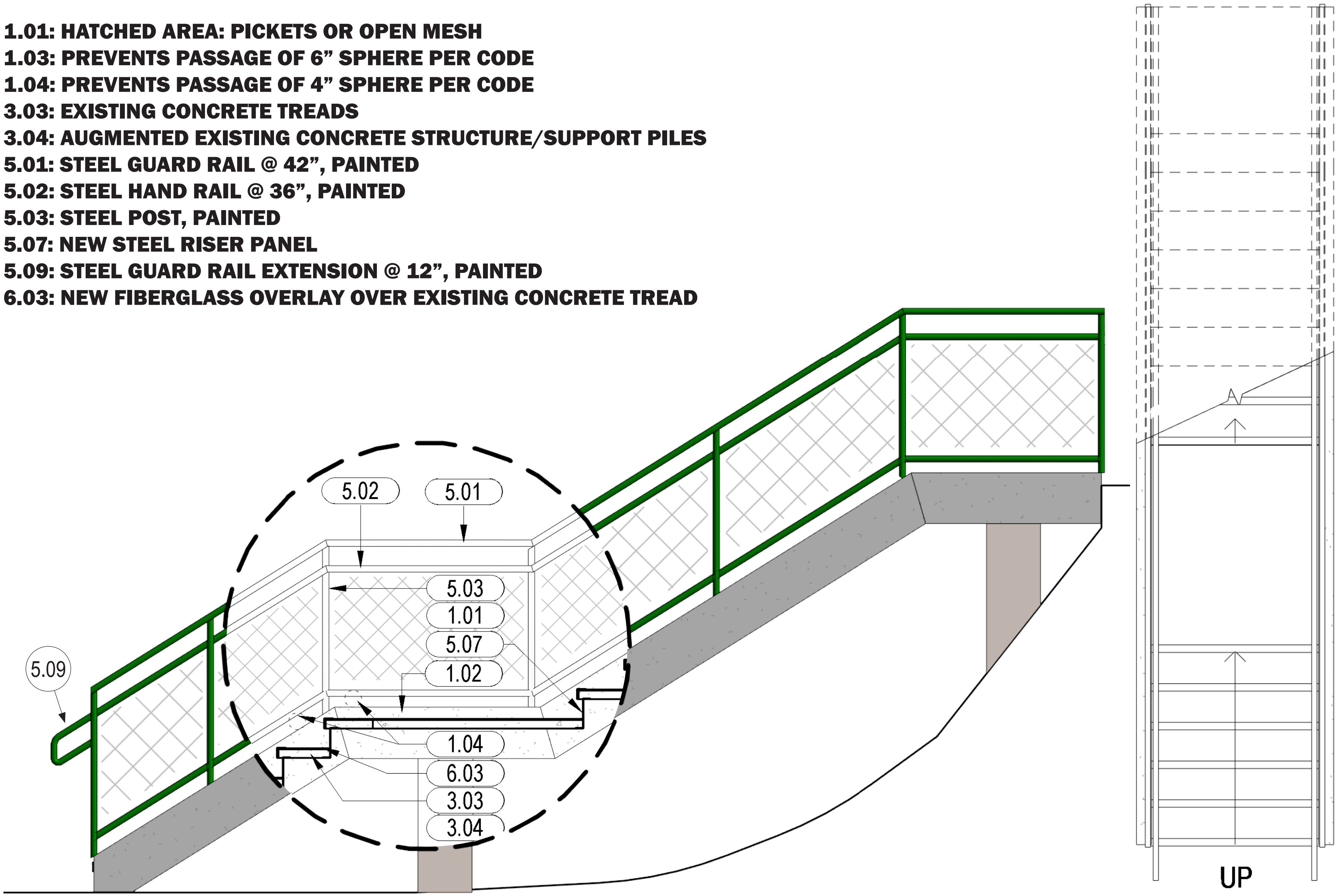
NATIONWIDE BEST PRACTICES

Cincinnati, Seattle, and Portland have not yet constructed steps using fiberglass.



REHAB CONCRETE STEPS
DIAGRAMS

1.01: HATCHED AREA: PICKETS OR OPEN MESH
1.03: PREVENTS PASSAGE OF 6” SPHERE PER CODE
1.04: PREVENTS PASSAGE OF 4” SPHERE PER CODE
3.03: EXISTING CONCRETE TREADS
3.04: AUGMENTED EXISTING CONCRETE STRUCTURE/SUPPORT PILES
5.01: STEEL GUARD RAIL @ 42”, PAINTED
5.02: STEEL HAND RAIL @ 36”, PAINTED
5.03: STEEL POST, PAINTED
5.07: NEW STEEL RISER PANEL
5.09: STEEL GUARD RAIL EXTENSION @ 12”, PAINTED
6.03: NEW FIBERGLASS OVERLAY OVER EXISTING CONCRETE TREAD



Next Steps

The process outlined in this document is only a first step in the challenging work of bringing one of Pittsburgh's beloved assets into a state of good repair. The prioritization process, best practices research, material guidelines and funding matrix outlined in this document provide the tools to take on the following actions over the next few years.

1. **Establish Community Priorities:** this prioritization process was built on demographic and geographical information. It might miss some of the contextual information that make a staircase important or useful. Discussions with community groups can help identify steps that have been ranked highly on paper but might not be a high community priority due to adjacent land uses or street conditions. The City team will follow up with community groups with 10 or more steps to confirm or adjust the 'top steps' list into a project list.

2. **Conduct Conditions Assessment:** using the prioritized list of top steps, the City will perform an initial engineering assessment of all 'top steps.' The assessment will document the condition of the steps and assign a category to help determine future action: "Rebuild," "Major Rehabilitation," or "Maintain and Steward." For steps categorized "Rebuild" and "Major Rehabilitation," cost estimates for repair will also be prepared.

3. **Identify Stewardship Opportunities:** throughout this process one thing was clear: residents are passionate about Pittsburgh's staircases and want to play a larger role in their care. To encourage this, the City will look into creating opportunities for stewardship. Since the steps are on steep slopes and often surrounded with invasive species, these collaborative activities must take into account the expertise required to work in these areas. The City will look for ways to pair volunteer labor and other resources from community groups with horticultural expertise to help address the negative impact of invasive species on some of the City's steepest slopes.

4. **Project List:** using the conditions assessment and cost estimate, the City will create a project list with cost estimates and a timeline for step replacement, major rehab and significant repair. This project list will guide the reinvestment in the City's core step network.

5. **Seek Funding:** using the funding matrix in this report, the City, with support from community groups, will seek out funding for high-priority step projects from various internal, intergovernmental, and external sources.

6. **Prioritize Routine Maintenance:** the Department of Mobility and Infrastructure will work with the Department of Public Works to prioritize key staircases for snow removal, weed removal and general maintenance.

7. **Encourage Enhancements:** consider enhancements such as lighting, public art, or signage within the steps on the 'top steps' list. These enhancements will have to fit within the condition of the steps or be incorporated into a construction project when funding for a re-build is identified.

8. **Develop Design Standards:** using the design guidelines in this report, the Department of Mobility and Infrastructure will update the City's staircase design standard to bring the construction detail for city steps up to current ADA codes and best practices.

9. **Schedule Proactive Work:** using the City's asset and work order management system, the Department of Mobility and Infrastructure will schedule recurring inspections and maintenance work for staircases, particularly those identified as priorities through this process.

10. **Decommission:** as it has done in the past, the city will continue to monitor and evaluate threats to public safety for the entire network, and will decommission steps when they pose a risk to the public.

5. Links

2.1.2

Pinnacle Metal Products

http://www.pinnmetalstairs.com/

Gray Welding and Fabrication Services, Inc.

http://www.graywelding.com/stairsrailings.html

Karnel, Inc.

http://karnel.rtrk.com/?scid=1847838&rl_alt=http%253A%252F%252Fwww.karnel.com

Brandywine Valley Fabricators, Inc.

http://www.brandywinevalleyfab.com/pipetube-bending/

2.1.6

Ametco Manufacturing Corporation: Railing Systems

https://www.ametco.com/pdfs/2011AMETCORAILINGSYSTEM13843.pdf

2.2.3

PIE Consulting and Engineering

http://www.pieglobal.com/articles/installing-exterior-stairs-choose-a-lasting-design/

2.2.4

GalvanizeIt! Designing for Hot-Dip Galvanizing

https://www.galvanizeit.org/designing-for-hot-dip-galvanizing/inspection/touch-up-and-repair

SlipNOT: Slip Resistant Stainless Steel Products

http://www.slipnot.com/case-studies/stain-less-steel-hurricane-sandy-project

2.2.6

Safe T Metal: Integral Tread Riser

http://safetmetal.com/wp/products/integral-tread-riser-itr

Amstep Products: Tread and Coating Color Charts

http://www.amstep.com/color-charts.html

Grainger: Anti-Slip Stair Treads

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McNichols: Quality Hole Products

http://www.mcnichols.com

All American Grating: Product List and Specifications

http://www.aagrating.com/aagCatalog.pdf

All American Grating: Grating Stair Treads

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Amstep Products: Anti-Slip Safety Stair Treads

http://anti-slip-stair-treads-nosings.amstep.com/configurator/711h-safety-stair-treads

Safeguard Technology: Step Covers

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Amstep Products: Sightline High Visibility Anti-Slip Stair Treads and Stair Nosings

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3.2.4

Zoro: Stair Tread

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WatcoL FRP Non Slip Stair Covers

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Fibergrate Composite Structure: Stair Tread Covers

http://www.fibergrate.com/products/stair-solutions/stair-tread-covers/

4.1.2

Virtual Polymer Compounds, LLC: Ladders, Platforms, and Railings

http://www.vpcfiberglass.com/ladders.shtml

San Diego Plastics: Round Fiberglass Handrail System

http://www.sdplastics.com/safrail.html#round

Strongwell: SafRail Fiberglass handrail and ladder systems

http://www.sdplastics.com/SAFRAIL_Brochure_1004.pdf

4.1.6

Bedford Reinforced Plastics: Design Guide

http://bedfordreinforced.com/wp-content/themes/bedford/pdf/brpdesignguide-2-2016.pdf

4.2.2

Strongwell: Duratread Fiberglass Stair Tread Covers

https://www.strongwell.com/wp-content/uploads/2013/04/DURATREAD-Flyer.pdf

Liberty Pultrusions: UltraGrate Fiberglass Grating

http://www.libertypultrusions.com/wp-content/uploads/2014/10/Fiberglass-Grating-Options.pdf

4.2.4

Industrial Fiberglass Specialties, Inc: UV Resistance of FRP Composite Architectural Products

http://www.ifs-frp.com/wp/pdf/technical-bulletins/sun-vs-frp-ifs.pdf

4.2.5

Smith Fiberglass: Chemical Resistance Guide

http://www.corrosionfluid.com/assets/pdf/smith-fibercast-fiberglass-pipe-piping-chemical-resistance-guide.pdf

4.2.6

Fibergrate Composite Structures: Fiberglass Stair Solutions

http://www.fibergrate.com/media/166922/stair-solutions.pdf

Koffler Sales Company: Anti Slip Stair Treads and Nosing

http://www.kofflersales.com/p/stair-treads-and-nosing-fiberglass.asp

Direct Metals: Fiberglass Stair Treads and Covers

http://www.directmetals.com/dm/products/fiberglass-grating/fiberglass-stair-treads-covers.html

McNichols: Quality Stair Tread Covers- Fiberglass molded products

http://www.mcnichols.com/products/stair-tread-covers/fiberglass-molded

National Grating: Fiberglass Stair Treads Price and Delivery

http://nationalgrating.com/fiberglass-stair-treads/

APPENDIX

City of Pittsburgh

City Steps Replacement Options

June 8, 2018

Estimate Clarifications

The basis for this Opinion Of Probable Cost was established using the following assumptions

The Estimate is based on the best available information regarding the anticipated scope of the project. Changes in the cost elements are likely to occur as a result of new information and data collected during the design and engineering process. Major changes should be documented in the form of a memorandum to the administrative record file with an explanation of significant differences.

Detailed quantity surveys and or systems pricing were NOT performed for this project. The design is at a conceptual level and the limit of definition for the program was:

Opt A - Precast Concrete. Includes PC treads, risers, and landing, 2 pipe railing with mesh, and concrete piers/columns
Opt B - Cast-In-Place Concrete. Includes free-standing treads, risers, and landing, 2 pipe railing with mesh and concrete piers/columns
Opt C - Wood. Includes PT stringers, treads, risers, posts, and landing, with wood railing
Opt D - Steel Concrete. Includes steel stringers. grating treads, plate risers, grating landing, steel framing, 2 pipe railing with mesh and concrete foundations
Opt E - Fiberglass. Includes fiberglass treads, risers, and landing, steel framing, 2 pipe railing with mesh, and concrete foundations
Opt F - Rehab Existing Stairs. Includes capping treads with fiberglass tread, adding steel riser inserts, and reinforcing/repairing concrete structure.

The pricing used reflects the probable construction costs for current dollars. All owner SIOH, design, and CM fees have been EXCLUDED.

Assumes that there is adequate access for construction crews and equipment. No consideration has been given to constructability of each scenario. This estimate assumes that the stairs section are being constructed in ideal conditions.

This estimate excludes any demolition of existing stairs or foundations.

This estimate excludes any rock removal and assumes there are no unsuitable soils.

Additional costs relating to crane rentals or concrete pumps have been excluded as it is assumed that the contractor will be responsible for determining the methods of construction based on the option selected.

Labor, Material, and Equipment pricing are based on RS Means 2017 published cost data for the Pittsburgh, PA area, along with online vendor quotes, and historic data from similar projects.

SUMMARY

City of Pittsburgh
City Step Options

6/8/2018

Description	Units	Qty	Unit Cost	Total
Pre-Cast Concrete Steps	LOC	1		**$ 23,556**
Cast-In-Place Concrete Steps	LOC	1		**$ 23,573**
Wood Framed Steps	LOC	1		**$ 10,416**
Steel Grating Steps	LOC	1		**$ 33,751**
Fiberglass Steps on Steel Framing	LOC	1		**$ 37,064**
Rehab Existing Stairs	LOC	1		**$ 25,796**

Notes:

1. Pricing for new stair options EXCLUDES any demolition of existing stairs
2. Pricing may vary greatly depending on access and difficulty of terrain at each location. Current estimates assume 100% productivity
3. Rehab Option would be least affected by site conditions

Precast Stair Option

2 Flights of 7 risers with 3' landing, 6'W 8/23/2017

Description	Units	Qty	Unit Cost	Total
12" CIP Piers (8' total length, 4' below grade), includes auger hole	EA	6	$ 575	$ 3,450
Precast Tread and Integral Risers	EA	14	$ 315.00	$ 4,410
Precast Landing	SF	18	$ 35.00	$ 630
Steel Angle and plate connections	LS	1	$ 500.00	$ 500
2 Pipe steel Railing, Galv. 1-1/2" dia	LF	40	$ 85	$ 3,380
Add for Expanded Metal Mesh on Railing **	LF	40	$ 90	$ 3,600
Subtotal				$ 15,970
Contractor's OH&P	%	18%		$ 2,875
Estimating Contingency	%	25%		$ 4,711
Total				**$ 23,556**

Cast in Place Stair Option

2 Flights of 7 risers with 3' landing, 6'W 8/23/2017

Description	Units	Qty	Unit Cost	Total
12" CIP Piers (8' total length, 4' below grade), includes auger hole	EA	6	$ 575	$ 3,450
Cast in Place Tread and Riser	EA	14	$ 330.00	$ 4,620
Elevated Slab Landing	SF	18	$ 24.00	$ 432
Steel Angle and plate connections	LS	1	$ 500.00	$ 500
2 Pipe steel Railing, Galv. 1-1/2" dia	LF	40	$ 85	$ 3,380
Add for Expanded Metal Mesh on Railing **	LF	40	$ 90	$ 3,600
Subtotal				$ 15,982
Contractor's OH&P	%	18%		$ 2,877
Estimating Contingency	%	25%		$ 4,715
Total				**$ 23,573**

Wood Stair Option

2 Flights of 7 risers with 3' landing, 6'W 8/23/2017

Description	Units	Qty	Unit Cost	Total
4x4 PT Wood Posts, set in concrete (8' total length, 4' below grade	EA	6	$ 275	$ 1,650
2x12 PT Wood Stringers	LF	52	$ 12.00	$ 624
PT Wood Treads	EA	14	$ 115.00	$ 1,610
PT Wood Risers	EA	14	$ 65.00	$ 910
PT Wood Landing	SF	18	$ 21.00	$ 378
PT Wood Railing	LF	40	$ 10.00	$ 400
PT Wood Railing Balusters 2x2	EA	116	$ 8.75	$ 1,015
Painting	LS	1	$ 475	$ 475
Subtotal				$ 7,062
Contractor's OH&P	%	18%		$ 1,271
Estimating Contingency	%	25%		$ 2,083
Total				**$ 10,416**

Steel Grating Stair Option

2 Flights of 7 risers with 3' landing, 6'W 6/1/2018

Description	Units	Qty	Unit Cost	Total
Column Footings	EA	6	$ 350	$ 2,100
Steel Framing & Columns	TON	0.75	$ 5,200	$ 3,900
Steel Stringers	LF	40	$ 50.00	$ 2,000
Steel Grating Treads with Plate Toe Kick	EA	14	$ 215.00	$ 3,010
Metal Grating Landing	SF	18	$ 60.00	$ 1,080
Steel Angle and plate connections	LS	1	$ 500.00	$ 500
2 Pipe steel Railing, Galv. 1-1/2" dia	LF	40	$ 85	$ 3,380
Add for Expanded Metal Mesh on Railing **	LF	40	$ 90	$ 3,600
Painting	LS	1	$ 1,200	$ 1,200
Subtotal				$ 20,770
Contractor's OH&P	%	30%		$ 6,231
Estimating Contingency	%	25%		$ 6,750
Total				**$ 33,751**

Fiberglass Stair Option

1 Flight, 7 risers with 3' landing, 6'W

8/23/2017

Description	Units	Qty	Unit Cost	Total
Column Footings	EA	6	$ 350	$ 2,100
Steel Framing & Columns	TON	0.75	$ 5,200	$ 3,900
Steel Stringers	LF	40	$ 50.00	$ 2,000
Fiberglass Treads	LF	14	$ 220.00	$ 3,080
Fiberglass Riser Toe-Kicks	LF	84	$ 70.00	$ 5,880
Fiberglass Landing on Steel Frame	SF	18	$ 16.00	$ 288
2 Pipe steel Railing, Galv. 1-1/2" dia	LF	40	$ 85	$ 3,380
Add for Expanded Metal Mesh on Railing **	LF	40	$ 90	$ 3,600
Painting steel structure	LS	1	$ 900	$ 900
Subtotal				$ 25,128
Contractor's OH&P	%	18%		$ 4,523
Estimating Contingency	%	25%		$ 7,413
Total				**$ 37,064**

Rehab Existing Concrete Stair

2 Flights of 7 risers with 3' landing, 3'W 6/6/2018

Description	Units	Qty	Unit Cost	Total
Supplemental Column Concrete	LOC	6	$ 650.00	$ 3,900
Patch/Repair Existing Concrete Tread	EA	14	$ 50.00	$ 700
Fiberglass Tread Overlay	EA	14	$ 175.00	$ 2,450
1/8" Pre-Finished Diamond Plate Riser	EA	14	$ 125.00	$ 1,750
Patch Landing	SF	18	$ 5.25	$ 95
2 Pipe steel Railing, Galv. 1-1/2" dia	LF	40	$ 84.50	$ 3,380
Add for Expanded Metal Mesh on Railing **	LF	40	$ 90.00	$ 3,600
Subtotal				$ 15,875
Contractor's OH&P	%	30%		$ 4,762
Estimating Contingency	%	25%		$ 5,159
Total				**$ 25,796**

** Note: These items are included to bring existing stairs into ADA compliance.

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