Thinking *Inside* the Box

Affordable Student Container Housing:

A Feasibility Study

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Executive Summary

Off campus living within Bellingham has significantly increased and gentrification has made it difficult to create sustainable low-priced apartments for college students. The goal for this project is to create community and campus opportunity through affordable student housing. The affordable housing will allow students to live at an inexpensive rent while also promoting sustainability by reusing shipping containers. Our current development plans have the housing located in a lot near Barkley Village where students are able to bus to Campus. The structure will be a series of shipping containers stacked upon each other, one student per container. The housing will contain standard apartment essentials such as a plumbing, power and living space.

The following report includes how the sustainable student housing project will be successful. It includes a proposed budget, documentation of the appeal to students, and further recommendations. The collected data is categorized by construction time, total construction cost, cost per-unit, monthly rent, size (in sq.ft.), and number of units. This data helps Western understand and decide what construction tactics are needed to make this project successful.

Outreach to students and faculty will be conducted via a flyer to handout and inform students. The flyers will contain basic information on the container apartments, asking students what they want for the design, and making sure the students voice is heard. For future development on the shipping container project, recommendations focused on student affordability and community input. Western will focus on the project's accessibility by creating a Shipping Container Club. The club will allow Western students to continue the research and collect data for future development towards apartments.

The overall goal of this report is to collect data that will help Western determine the best design for the shipping container apartments and to create a flyer to help Western students construct future ideas for the project, in relation to what the students want when living in the apartments.

Introduction

Students are finding it increasingly difficult to find apartments to live in because of increasing rent in Bellingham. “The median rental rate for a single bedroom apartment in Whatcom County was $1,623 a month in February (2018), a 5.6 percent increase compared to a year ago,” (Gallagher, 2018, Web). As the rent in Bellingham increases, the opportunity for equitable price housing diminishes. The sustainable housing project’s goal is providing reasonably priced apartments for students of Western Washington University. Western will provide housing through retrofitted shipping containers, providing an affordable and sustainable way of living.

Since the project requires extensive information and data, the objective was to collect data on why living in container apartments would be a viable option for addressing increasing rental prices. The project consisted of three goals: looking for possible designs and concepts for the apartments, creating a feasibility report by comparing and contrasting apartments, and lastly creating a flyer to inform students. Satisfying these three goals will determine the project’s success and completion. The data within the report was difficult to compare since some of the consulting projects were funded privately and others through government, making it difficult to estimate what our average funding would be. The data was collected through a series of articles focusing on the dorm construction within the foreign case studies, Keetwonen and Rouen.

Lastly, the project will provide a flyer to handout, outlining basic information on the shipping container apartments. These flyers will inform students about the accessibility the shipping container dorms provide. The purpose of the flyer is to garner attention for the project while also getting additional feedback from students and faculty.

Research includes an analysis of existing apartments located within Western Washington University, University of Amsterdam and University of Rouen. Analysis of the University of Amsterdam and University of Rouen focused on how their respective container housing was effective at creating affordable student housing, the speed of their construction, and the cost per unit.

Research

Case Studies

Keetwonen

Located in the Netherlands, University of Amsterdam previously had high demand for student housing. In 2004, more than 6,000 students were on a waiting list for housing. In 2006, to increase campus housing, the University of Amsterdam constructed a 1,000 unit container apartment building (Living Spaces, 2014).

After analyzing the Amsterdam complex, the descriptions sounded very similar to what the outline or blueprint for Western's shipping container housing might be. The containers have two rooms divided by a narrow hallway, with a kitchen and bathroom included. The cost per unit of shipping containers were approximately €20,000 ($28,000). This was without tax, but including infrastructure costs such as stairways, balconies, water, and gas networks (Uittenbroek & Macht, 2015, Pg.7).

Rouen

Rouen University, located in France, constructed 100 new student dorm rooms created by transforming old shipping containers into a four-story building. Each apartment is 24 square meters and includes a bathroom and a kitchen (Caroline Uittenbroek, 2009). Rouen University's plan was not successful, their project did not meet the number of students seeking housing at the time and was insufficient to meet the demand. However, the creation of the dorms was a solution to build quickly and cheaply while offering students accommodation. While the total cost of production should have been 25% lower than that of a traditional residence, because of the assembly issues and weather damage, the overall cost per unit was €50,000 which converts into $56,015.25 per container dorm (Le Parisien, 2010).

Birnam Wood

Birnam Wood is an off campus apartment complex managed by WWU, the apartments were built in 1974. The rent is under $400 a month including benefits like free laundry, internet, and cable. Each of the units house four students, two per bedroom. It is the only student housing that does not require a meal plan (Samantha, 2016). However, the apartments are only for upperclassmen.

Buchanan Towers

Buchanan Towers was built on Western's campus during 1971. Its construction was built for stability rather than affordability, focusing on the brickwork and steel frame of the eight-story student apartment building (Buchanan Towers Newsletter, 1971). The dorm was constructed on the southern perimeter of the campus. The $3,850,000 structure was built to house 400 students.

In a departure from more traditional dormitory housing, the dorms have individual living and cooking quarters with two to four students sharing apartment units. The units include benefits like free laundry, internet and cable (WWU, 2018).

Modular Construction

Modular construction is a term describing off-site warehouse built construction. Modular construction is essential in keeping construction costs low, and thus keeping rent low. There are two kinds of modular construction, permanent (PMC) and relocatable or temporary. Permanent modular construction refers to construction meant to be assembled and constructed permanently at a location. "Although permanent modular construction (PMC) has been flourishing for a decade or more in Europe, it is an emerging market in North America," (Smith, p.1).

There are several reasons why much of Europe uses modular construction as a means to lower construction costs. One being weather and temperature related delays, "No matter where your building or expansion project takes place, stick-built construction projects will face delays caused by unfavorable weather conditions," (Vanguard, 2019). Not only does modular construction completely eliminate weather setbacks, "Modular construction transfers unpredictable on-site risks to controlled offsite facilities. In so doing, traditional risks born by contractors are often shifted to other parties. This allows contractors to limit the need for expensive general liability policies," (George & Klein, 2018).

Modular construction is particularly relevant to shipping container housing. This is because the dorms fit perfectly on a standard semi-truck, making transportation and maneuverability relatively easy. Modular construction has more recently been associated with ideas of sustainability as, "There is also less waste when building modular structures and with build time being half that of traditional building methods," (Hedmond, 2017).

General Feasibility

Though shipping container modular housing has been completed successfully at a low cost, there are specifics that raise the cost of shipping container structures. Because shipping containers are made of steel, "Modifying containers requires welding and cutting skills, which are considered to be a specialized labor, which adds to the construction cost," (Brandt, 2011, p.11). As the project advanced, data showed limiting the amount of modifications such as windows and doors, especially on the longer walls of the containers, reduces the need for such expensive labor. What steel lacks in affordability however it makes up in durability. Steel is water, mold, and fire resistant. One thing for sure, these materials are abundant in the United States: "The country's trade deficit (the U.S. imports more goods than it exports) has lead to the retirement of thousands of lightly used containers," (Martinez-Garcia 2014, p.1).

Because shipping container structures are a fairly new innovation, proper permitting and zoning can be difficult. “Local zoning in most instances does not address container housing. Modifications such as a permanent foundation and pitched roof (Downs, 2014) may be required to adhere to local building code if permitted at all,” (Martinez-Garcia, 2014, p.15). However, much of the complaints surrounding already made structures come down to aesthetics. Gary Imhoff of DC Watch infamously states that, “Prefab shipping container houses can be made to look nice in architect’s plans. So can trailer parks. But I suspect that a few decades of wear will quickly turn them into slums,” (Martinez-Garcia, 2014, p. 11). This project assumes that the trendability of shipping containers and tiny homes will continue and remain stable, and as eco-consciousness becomes more popular, so will the look of reused building materials.

Methodology

A benchmarking approach was used as a tool for comparison and to create a digestible format to compile research. This approach took the form of an Inventory Template. Three institutions were chosen to investigate, including WWU Buchanan Towers, WWU Birnam Wood, the Keetwonen shipping container student housing at the University of Amsterdam, and the University of Rouen shipping container student housing. These categories reflect the concerns and hopes regarding reduced cost of shipping container construction as well as rent. An informative breakdown of the template categories and institutions is listed below.

Inventory Template

	Construction Time	Construction Cost (Per unit)	Construction Cost	Rent (Monthly & Including Utilities & Amenities)	Square Footage (1 unit)	Residents/ Unit #
WWU Buchanan Towers*						
WWU Birnam Wood						
University of Amsterdam - Keetwonen						
University of Rouen						

*Western Washington University is in the middle of a two-year, $24.5 million renovation of the Buchanan Towers residence hall on south campus. This cost will not be accounted for in our Construction Cost.
https://housing.wwu.edu/living-on-campus/residential-communities/buchanan-towers-renovation

Inventory Template Breakdown

Categories

Construction Time

A significant benefit of shipping container housing is a fast construction time. This category will describe how long it would take a shipping container structure to assemble while comparing it to traditional building construction.

Construction Cost

Perhaps the most important category as far as pitching this idea to Western's administration would be how much it would cost to build in comparison to what they are currently spending on dormitory construction. It is beneficial for this project to understand which universities have already done this successfully, and at the lowest cost.

Rent (Monthly)

The main priority of this project is to provide a low income option for students, therefore having a straightforward comparison between our project's predicted rent alongside other similar institutions and Western's current on-campus rent will hopefully provide significant intrigue from students looking for a more affordable option.

Square Footage

Potential housing residents and students are often concerned with the amount of space container housing can provide. Including this category will allow students to get an idea of the difference between a more traditional student apartment layout in comparison to a studio-style container home.

Institutions

WWU Buchanan Towers

An 8-story dormitory housing on Western's campus designed to "house 402 occupants in two and four-person units with individual cooking and eating facilities," constructed in 1971 (Buchanan Towers Newsletter, 1971).

WWU Birnam Wood

An apartment style housing complex managed through WWU located off Western's main campus at a lower cost to students built in 1970. The building is 132 units and is meant to house 528 students. These dormitories are only available to upperclassman (Birnam Wood, 1970).

University of Amsterdam (Keetwonen)

This apartment-style "development features 1000 units of 'upcycled-container' studio flats" each including a private kitchen, bathroom and balcony. The project was completed in 2006 (Keetwonen).

University of Rouen

A 4-story shipping container dormitory housing at the University of Rouen in Le Havre, France designed to house 100 students in studio-style dorm rooms. Constructed in 2010 (Docks, 2018).

Results

Inventory Template

Fig. 1

	Construction Time	Construction Cost (Per unit)	Total Construction Cost	Rent (Monthly & Including Utilities & Amenities)	Square Footage (1 unit)	Residents/ Unit #
WWU Buchanan Towers*	18 months	Estimated cost with inflation $181,289	3,850,000 ($24,292,834.57 w/ inflation)[1]	Estimated single room $1,012	446[2]	402
WWU Birnam Wood	8 months	$128,767	$14,937,057.22[4]	Estimated single room $838	845	464
University of Amsterdam - Keetwonen	9 months	$36,000[3]	$37,224,000	$600	322.917	1000
University of Rouen	<1 year	$56,162.10	$5,378,328	$337	269.098	100

1. Rate of inflation used: 531.0%, source: https://www.usinflationcalculator.com/
2. One double room plus shared living space (kitchenette & bathroom)
3. This number has been estimated to reflect today's current pricing
4. Rate of inflation used: 558.6% source: https://www.usinflationcalculator.com/

*Western Washington University is in the middle of a two-year, $24.5 million renovation of the Buchanan Towers residence hall on south campus. This cost has not been accounted for in our Construction Cost.

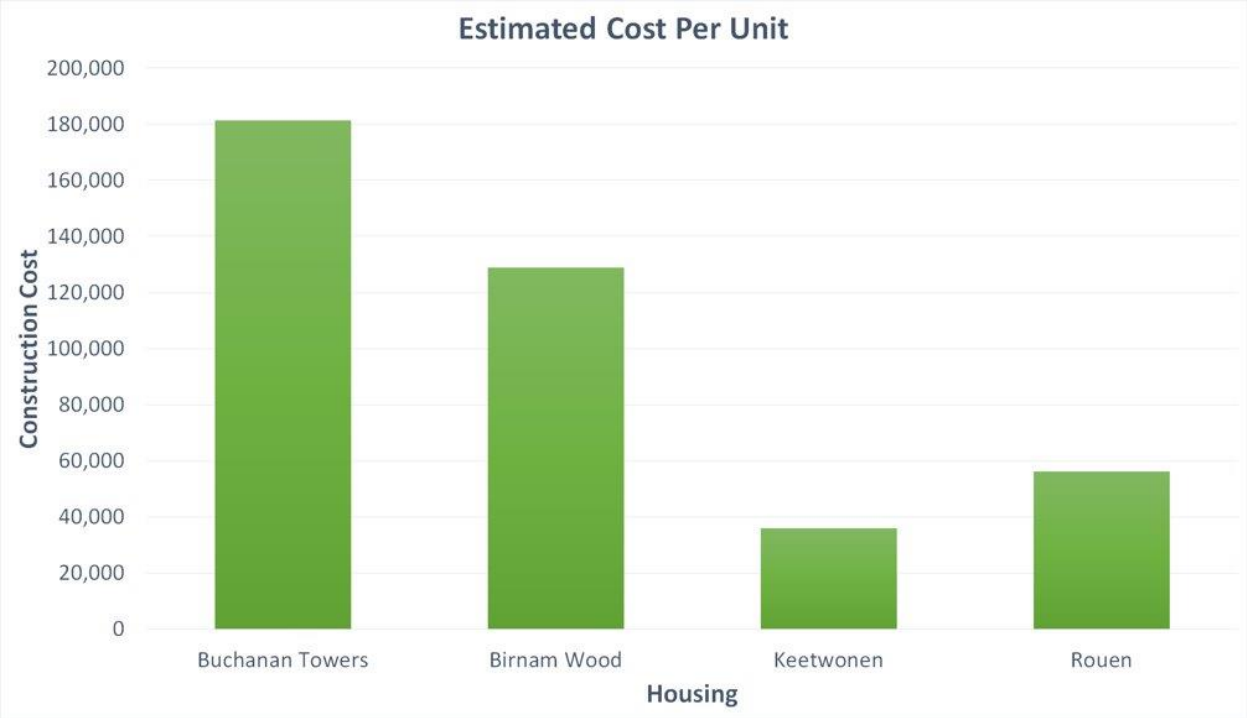


Fig. 2: Estimated cost of construction per unit for each case study

Analysis

Through extensive research with the help of stakeholder for the project, Darrin Gordon, a research assistant at the Office of Sustainability, and visits to the University Archives, the Inventory Template was completed. Some of the most interesting points to highlight in looking at these comparisons side by side is the high number of units to a lower construction cost ratio of the shipping container apartment structures in contrast to Western's current facilities. It is also important to note that the Birnam Wood residences run through Western Washington University are currently the lowest rent available of all WWU dormitories but are not available to freshman. This means that all freshman (not including special circumstance) would be required to pay the estimated $1,012 monthly rent to live in on-campus facilities. This number also does not reflect meal plans that are also a requirement for on-campus students. This data highlights the need for a low-income option for incoming students as well as upperclassmen.

The lower construction costs of the shipping container structures is largely due to the significantly lower construction time due to off-site assembly. 1,000 studio-style units were constructed at the University of Amsterdam in half the time it took to build Buchanan Towers. Obviously, new construction technologies should be considered in making this comparison as Buchanan Towers was completed in 1971 whereas Keetwonen was completed in 2006, however two years (2019-2021) is still the predicted amount of time it will take to complete Western's new dormitory plans on the ridgeway.

Estimations Student Alternative Container Housing

Construction Time	Total Construction Cost	Rent (Monthly)	Square Footage (1 unit)	Residents/ Unit #'s
<1 year	$20,000,000	(450)	322.917	400

How We Reached These Estimations

These estimations were reached after compiling research and Inventory Template data to create a simplistic and generalized estimation chart of our Student Alternative Container Housing. Each container would be furnished as a studio-apartment style fit for single occupancy, or for couples. Each container would be fitted to house one bathroom, a small kitchenette, and a double or single bed (examples have been provided below). The containers used for construction would be *used* standard ISO Shipping Containers, 40 feet in length, 8 feet wide, and 8.5 feet high. 400 studio apartments would be built with a total of 402 containers used, the extra two units to house heating and power (Student Housing Diemen). Construction time with apartments assembled off-site in Seattle would take less than a year after delivery this largely in part to their easy-to-maneuver block-like shape and their transportability.

The most generalized figure is estimated construction cost, unfortunately, because a project of this scale has never even been attempted in the United States, it is difficult to convert and understand exact numbers through international case studies alone. This is exciting because if institutions across the globe, not just limited to our case studies alone, are adopting shipping container student housing due to its ability to house many students at a low cost, then it is possible in the United States, and at Western Washington University. The estimated number of $20,000,000 comes from an average of the Keetwonen construction cost per unit and University of Rouen's construction cost per unit multiplied by our 402 unit structure for a total of $18,524,582. In order to provide room for unaccounted higher costs due to a lower level of technological and construction knowledge within the United States concerning modular construction, this number has been rounded to $20,000,000.

Recommendations

It is recommended that our stakeholder use the created flyer to conduct either a survey of student opinion or a focus group. The flyer can also be used to garner student support and advance collaboration efforts especially with industrial design and urban planning and development students. The main recommendations would be to create an AS club on Western's campus dedicated to seeing this project implemented. As a club, this project would be open to mass information and critique by the student body, thus strengthening the project's overall span. It is urged that this club follow some of these suggestions in the continuation of this project. These include:

- Remaining mindful & conscious of Western's low-income student community and prioritizing diversity in the completion of this project.
- Exploring new land options; particularly ones closer to campus to avoid sprawl and reduce student commute.
- Gather data on Western's new ridgeway dormitory cost and construction, scheduled for completion in Fall 2021
- Remain informed on new innovations regarding modular construction, particularly within the U.S.

This generalized timeline should be referenced for the continuation of this project to its final implementation. This timeline is subject to change based on the gathering of new research regarding modular construction and any setbacks not accounted for.

Fall 2019	Winter 2020	Fall 2020	Winter 2021	Spring 2021-Winter 2022	Spring 2022	Summer 2022	Fall 2022
Use flyers as a method to garner student interest and support	Create AS Club dedicated to Affordable Student Container Housing	Finalize design concepts and draft proposal	Pitch Idea to WWU Housing	Project Approval through Administration	Off-site modular construction	On site construction	Project Completion, Apartments ready for Incoming Freshman

In order to successfully complete this project, emphasis must be placed on the importance of being mindful and conscious of Western's low-income students and fostering diversity within the community.

Monitoring and Evaluation

This project should continue into the Fall 2019 quarter with Darrin Gordon as the primary stakeholder. Expanding and adding to our timeline for the project, including key milestones in collaboration with Darrin, should be of great importance. Continuing the organization of data that our project has created, research should continue into any new innovation and developments implementing shipping containers-especially in the U.S. The data and research we have collected from universities such as University of Amsterdam and Rouen should be monitored and updated for any changes. This would also apply to any changes made in the rent/room & board costs of Buchanan Towers and Birnam Wood. The flyer template should be used to gather interviews or send out a survey in order to more fully understand student wants and needs regarding low-income shipping container housing. Collecting feedback from students would be essential to the eventual success of this project; discussing how to make the shipping container homes more suitable.

Tracking Western Washington University's construction of the new residence hall scheduled for completion in fall of 2022, design and cost of which will be finalized in August of 2019, will also be useful for drawing comparisons and having a more concrete actualization of Western's budget and construction timeline for new residence structures.

Ultimate success for this project greatly lies in its ability to expand into Western's many departments. Collaboration with not only University Residences and eventually the Board of Trustees, but engineering, urban planning, and industrial design students as well, among many others.

Budget

The budget for the project is ambiguous due to many currently unknown variables in such a large-scale project. As stated in the analysis and estimations above, a project of this scale using shipping containers has currently not been done within the U.S. Using data from European examples, the estimation for the total construction of the shipping container apartments would be around $20,000,000.

There are many hidden costs to constructing a massive apartment complex, including plumbing, wiring, insulation, heating, and indoor furnishing. The total cost of construction also depends on where the shipping containers are coming from, and whether they are purchased from a pre-assembly warehouse. Currently, Seattle-based companies such as Cargotecture are using methods of modular construction and assembling in off-site factories (J. Egan, Phone Interview, April 16, 2019). Using a modular construction warehouse in Seattle rather than somewhere out of Washington state could lower costs and ecological concerns related to transportation. There are also added costs for buying the land and addressing potential zoning problems that come with the unique nature of the project. It is possible for the school to receive grants to assist with the cost of building a new apartment complex.

Conclusion

In conclusion, Western Washington University needs to create affordable student housing to accommodate the increase in student body as well as the steady rent increases in the Bellingham area. This could be achieved by using shipping containers to build-high density studio apartments for students. This type of housing is quick to build and generally costs less for construction.

The lowest estimated cost of the shipping container dorms, for an apartment complex of 400 units, would cost approximately $20 million. This would be about one-third the cost of Western's Buchanan Towers, which have 402 units, and cost about $60 million to construct.

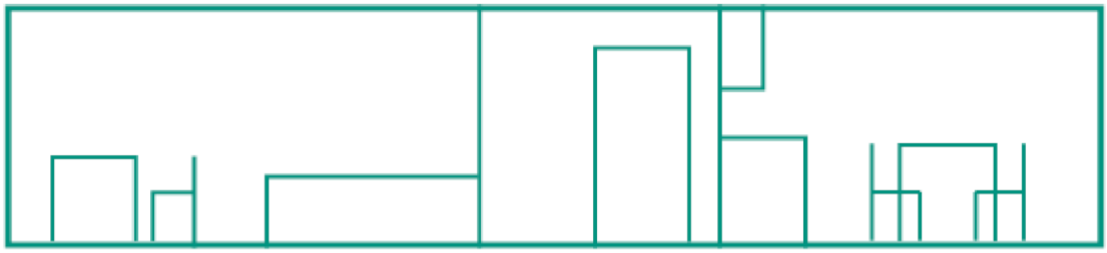
Once the time and effort needed is put into the planning process, the lower cost and the lower construction times will make a good case for the feasibility of building a shipping container apartment complex as affordable student housing.

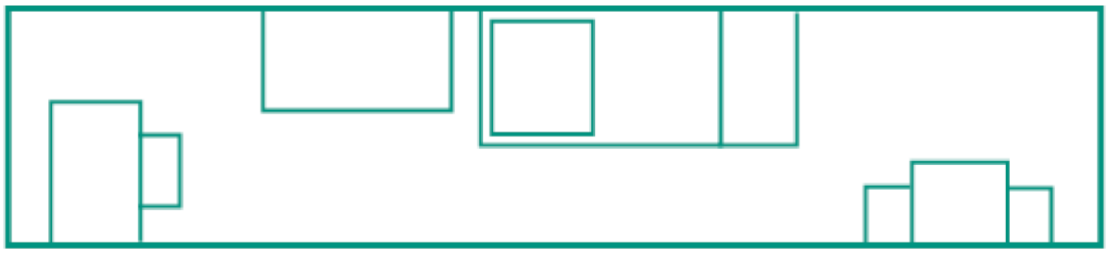
Recommendations for the future of the project include: Using the supplied flyer to bring awareness to the student population as well as for surveying students about how they would feel about the project; collaborating with Industrial Design and Urban Planning & Development students at Western; creating an AS club to give students a platform of open discussions, critiques, and information dealing with the project; looking into more options for a buildsite closer to campus; gathering data from the new ridgeway dorm; and keeping informed on the latest innovations of modular construction.

Flyer

Intended as an informational 8.5x11 double-sided flyer geared towards Western's student body, this flyer should be used to garner student collaboration, interest, and support regarding this project. It includes a simplified design concept for a container apartment, heavily influenced by Rouen and Keetwonen's designs.


WHAT IS IT LIKE TO LIVE IN A
SHIPPING CONTAINER???
JUST ASK THOUSANDS OF STUDENTS ACROSS THE GLOBE!





MORE SPACIOUS THAN YOU MIGHT THINK!

A project is in the works at WWU to provide inexpensive housing to students through the construction of shipping container apartments.

PROS:

- ▶ lower rent
- ▶ eco-friendly
- ▶ quick to construct

Shipping container housing and modular construction are being implemented as student housing structures at universities across the globe! Used shipping containers are not only environmentally friendly, but because of their low construction cost, are an ideal solution for Bellingham's housing shortage that is driving up high rents. Each unit acts as a private, studio-style apartment fit with individual bathroom and kitchenette.

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Fig. 1 & Fig. 2

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